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PRACTICAL APPLICATION OF ULTRA VIOLET LIGHT IN CERTAIN SKIN DISEASES*

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INTRODUCTION

Ultra violet light therapy is today receiving an unusual amount of attention from investigators and clinicians, and its introduction into dermatologic practice has led to a great deal of discussion as to its value in the treatment of diseases of the skin. As Butler (1) has stated in his excellent review of the subject, there have been exaggerated expressions of opinion; enthusiastic recommendation on the one hand, and unjustified condemnation and pessimism on the other. To the general practitioner whose knowledge of dermatology is necessarily limited, ultra violet light therapy has opened up an alluring vista, an easy and safe method of treatment, almost a panacea if one were to believe all that the manufacturers of ultra violet lamps claim. A satisfactory evaluation of this method of therapy has become possible only since dermatologists have given it serious study.

BASIC PRINCIPLES OF ULTRA VIOLET LIGHT THERAPY

The scientific study of light therapy dates back to the original observations of Finsen on

the cure of lupus vulgaris with concentrated sunlight. Many observers since then have demonstrated that the therapeutic energy of light is greatest in the shortest wave lengths, the ultra violet rays of the spectrum having the greatest bactericidal and stimulating effect. It has been repeatedly shown that micro-organisms are rapidly destroyed when exposed to the ultra violet radiation from mercury quartz lamps. The penetrating power of the various rays of the spectrum is inversely proportionate to their bactericidal power, the red rays being the most penetrating and the ultra violet the least. It is apparent, therefore, that the effect of ultra violet light is due only in part to the ability of the rays to penetrate the skin, to destroy bacteria and to produce regenerative changes. The effect of general irradiation on the body metabolism, on the enzymes of the blood, and on the chemical and morphologic constituents of the blood as well as on the skin is beginning to be more generally appreciated, and is being utilized to assist in the healing process.

TECHNICAL CONSIDERATIONS

The technic of using air-cooled (Alpine sun) and water-cooled (Kromayer) mercury vapor

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lamps is so well known that a detailed description may be omitted, and it will necessarily vary with each individual operator. The Kromayer lamp is generally considered the most useful in dermatologic practice because of its adaptability to small lesions or to the mucous membrane, and the possibility of obtaining greater penetration by compression and dehematization with the quartz lens. Scientific methods of measurement are very much to be desired, but will always have to be checked by clinical effects. The degree of erythema produced will depend on the time, the distance of the source of light from the area exposed, the rheostat, the permeability of the quartz window and the susceptibility of the skin to light rays (Schuyler Clark). When the quartz window is pressed firmly against the lesion greater penetration will be secured, and the interposition of blue quartz filters permits of prolonged exposures without an undue amount of inflammatory reaction. The dermatitis from exposure to the Kromayer lamp does not produce scarring, but does cause some pigmentation. Burns from over dosage can be avoided with reasonable care, and aside from being painful are rarely serious. In my own experience when giving distance radiation I prefer suberythema doses, or mild hyperemic reactions, followed by desquamation. It must be remembered that covered parts of the body are more sensitive to the rays than uncovered parts, and that blondes will react more readily than brunettes.

COMPARISON WITH X RAYS

Undoubtedly the brilliant results of x ray therapy in the past have done much to overshadow the less spectacular results of ultra violet light therapy. It has been repeatedly stated that the x ray in the hands of experts is the most valuable single agent in the treatment of skin diseases. In spite of modern instruments of precision and exact methods of measurement, injurious effects are still seen, and the personal equation of the operator and idiosyncrasy are not entirely negligible factors. From the medico-

legal standpoint at the present time an x ray injury is taken as *ipso facto* evidence of malpractice, and it is becoming increasingly difficult for physicians using x ray therapeutically to obtain legal protection. By comparison, ultra violet therapy has the advantage of comparative safety in that it can be used repeatedly without damage to the skin, it requires less technical knowledge, does not entail the danger of late sequelae, and can be combined with the usual dermatologic therapy. The thesis which I should like to defend is that the ultra violet ray is a useful adjunct to ordinary external and internal therapy in a variety of dermatoses, but should not be relied upon alone as a curative agent. I do not hesitate to apply to the skin such topical applications as iodine, mercurials, phenol, potassium permanganate, tar and other medicaments in proper percentages, either preceding or following the use of the quartz light. When employing the x ray one must be extremely careful about the use of irritating drugs. MacKee has shown that serious reactions may occur when strong antiseptics are used simultaneously with even small doses of x rays. I have seen a dermatitis go on to necrosis around an epithelioma under treatment with x ray when orthoform powder was applied for the relief of pain. It is imperative when using x rays either to use no other local treatment, or only mild and soothing applications. This does not apply to quartz light therapy and constitutes one of its advantages. It is obvious, however, that the indications for x ray and ultra violet light are by no means identical, and that the biological effects of these two agents are quite dissimilar. As a matter of convenience I have grouped the indications for quartz light therapy in skin diseases under seven heads.

INDICATIONS FOR ULTRA VIOLET LIGHT THERAPY IN DERMATOLOGY

1. *Staphylococcus and streptococcus infections of the skin.*

In this group we utilize the bactericidal properties of ultra violet light which have been dem-

onstrated experimentally by McCaskey, Janet Clark and Browning and Russ. Bayne-Jones and Linden have shown that the germicidal action of light coincides with the absorption spectrum of bacteria and increases in intensity with the shorter wave lengths. It is natural, therefore, to expect ultra violet exposures to be of service in such superficial streptococcus infections as impetigo contagiosa. In my experience these cases will recover in a shorter space of time when local irradiation is combined with the usual antiseptics employed in this disease (ammoniated mercury, boric acid). More deeply seated streptococcus infections such as the ecthymas are also benefited. In furunculosis I have found local and general irradiation valuable as part of the systematic sterilization plan of treatment. This includes such measures as frequent baths, frequent change of underclothing, antiseptic soaps, disinfection of the skin by various chemicals, restriction of carbohydrate intake, etc. Individual furuncles may at times be aborted by a compression treatment with the Kromayer lamp.

The cure of a localized axillary furunculosis, which is only too common in the female sex at the present time, can be facilitated with actinic light. Chatin has found ultra violet light valuable in controlling an epidemic of pyoderma in young children in day nurseries. In the treatment of staphylococcic sycosis, a peculiarly stubborn and resistant affection, ultra violet light has a definite value. These cases respond poorly, as a rule, to x rays either with fractional or epilating doses, even MacKee admitting numerous failures and recurrences. I have successfully treated a half-dozen cases by combining vigorous local actinotherapy with disinfection of the lesions with weak iodine solutions and bichlorid of mercury applications plus epilation by hand. A prolonged course of therapy may be necessary to secure results. In the cases localized on the upper lip and reinfected by the nasal discharge it is advisable to direct the therapy to the nasal condition as well.

2. *Parasitic skin diseases.*

Ultra violet irradiation plays a minor role in the treatment of parasitic skin diseases. The pruritus that persists after the usual sulphur therapy of scabies may improve under air-cooled irradiation, but other means accomplish the result equally as well. Tinea infection of the hands and feet and groin can at certain stages be improved by quartz light therapy when combined with local antiseptics, such as mercuriochrome or iodine. I have a distinct impression that recurrences can be prevented by ultra violet light after the infection has subsided. I have repeatedly irradiated favus of the scalp and microsporon infections with no result. Kerion and deep-seated ringworm of the beard respond more favorably, probably because the perifollicular suppuration favors extrusion of the hair. Here, again, it is difficult to evaluate the effect of ultra violet light when combined with other measures.

3. *The tuberculous group of skin diseases.*

The remarkable results of Finsen light treatment in lupus vulgaris have never been improved upon. Reyn of the Finsen Institute has convincingly shown that curative results in all forms of surgical and cutaneous tuberculosis are more rapidly secured when local phototherapy is combined with systemic carbon-arc lamp irradiations. He prefers the carbon-arc light because its spectrum more nearly approaches that of sunlight. Sequeira reports 70 per cent of permanent cures in lupus and also agrees that general light baths, by producing intense pigmentation and increase in weight, promote a rapid healing. Lupus vulgaris is, fortunately, rare in this country. The results of treatment with mercury vapor lamps are apparently not as striking. In a few cases I have had fair cosmetic results by combining intensive compression treatment with the Kromayer lamp with applications of liquor hydrargiri nitratis, as recommended by Adamson and myself.

Among other forms of cutaneous tuberculosis which have been successfully treated with quartz

light may be mentioned erythema induratum, scrofuloderma and tuberculosis verrucosa cutis. In five cases of papulonecrotic tuberculide under my care healing resulted from the combined use of neoarsphenamin intravenously, and local applications of quartz light. In twelve cases of lupus erythematosus I have never effected a cure with ultra violet rays, no matter what technic I have employed. For over a year I have been treating a child with an annular discoid lupus erythematosus of the cheek with pressure treatment, the lesion clearing in the central areas and steadily progressing at the periphery. In the disseminated cases quartz light has a decidedly harmful effect. It is only fair to state that cures have been reported by Kromayer, Schuyler Clark, Wise, C. A. Simpson and others. Finsen in his early work was successful in 33 per cent of his cases. It is my impression that ultra violet light is inferior to carbon dioxid snow and radium in the discoid type of erythematous lupus.

4. *Inflammatory skin diseases of unknown etiology.*

In this group ultra violet light may assist in the healing process by its local stimulating effect, and probably by the effect of the absorbed rays on the blood stream and general metabolism. The favorable response of parapsoriasis noted by Chipman, Schamberg and others, I can corroborate from personal experience. Quartz light appears to be superior to x rays in this disorder. Recent reports on the treatment of psoriasis have been encouraging. The pigmentation resulting from exposure to sunlight or ultra violet light undoubtedly modifies the course of the disease, and although not curative may delay recurrences. Alderson in America and Castle in England are enthusiastic in advocating Alpine sunlight irradiation in this disease. Goeckerman of the Mayo Clinic has devised the following technic which he states is effective in every form of psoriasis, no matter how long the duration: The lesions are covered for twenty-

four hours with crude coal tar ointment (White's formula). The excess of ointment is then removed with oil, leaving a thin film on the lesions. Following this exposures to the quartz lamp are made for one minute at 30 inches distance and increased one minute daily, after which the patient is allowed to take a bath. The time of exposure is rapidly increased and the distance decreased in order to promote a rapid tanning. Goeckerman states that he has been able to clear up nearly every case in three to four weeks, and if results are not obtained there has been some fault with the technic. On the question of permanency of results he is noncommittal, admitting that recurrences take place. The principal objection to this method lies in the use of the black coal tar ointment, which almost makes it a hospital procedure, but this applies equally to the usual chrysarobin treatment. In a small group of cases I have followed this technic and have been favorably impressed. Eight cases cleared up satisfactorily; two cases promptly relapsed after discontinuing treatment. In Goeckerman's opinion some ingredient of the crude coal tar acts as a sensitizing agent to the light, and the results are far better than when ultra violet light alone is used. In a stubborn disease like psoriasis in which x rays have to be used with great care the above method deserves a thorough trial.

The results of ultra violet irradiation in eczema are extremely variable. Acute cases may be aggravated, while chronic, thickened and sclerotic patches usually improve. I have found ultra violet light to be more effective when previous applications of crude coal tar ointment have been made, similar to the Mayo treatment of psoriasis. Theoretically, irradiation should be of greater value in what Pulay terms the anaphylactic type of eczema, characterized by eosinophilia, low calcium content of the blood, and increased potassium and blood sugar. Every case of eczema must, of course, first be investigated from every angle and all external sources of irritation ruled out. Ultra violet

light is not indicated in the ordinary type of dermatitis from external irritants. Lichen simplex chronicus of Vidal, or neurodermitis, responds brilliantly to a combination therapy of arsenic internally, diet, quartz light and crude coal tar. I have seen cases with lichenified patches of ten or fifteen years' duration clear up in a few weeks. X rays are also effective in this disorder.

In bullous eruptions such as pemphigus, Duhring's disease and erythema multiforme actinotherapy is of little value. Several observers have noted rapid improvement in pityriasis rosea, but this affection is practically self-limited and requires very little treatment of any kind.

5. Disorders of the sebaceous glands.

Both x rays and ultra violet light are useful adjuncts to carefully planned systemic and local medication in acne vulgaris. It is my impression that x rays are far superior to quartz light in their effects on this disease, and this appears to be the judgment of the majority of American dermatologists, including Pusey, MacKee, Fox, Markley and Wise. On the other hand, Butler and Sweitzer prefer the ultra violet light. Butler states that ten years' experience has convinced him of the superiority of ultra violet ray therapy in acne of all types. He advises exposures of sufficient duration to produce a severe and painful dermatitis during the first two or three sances, and milder exposures after this. In my own practice I make it a rule to employ x rays in the more deeply seated types of acne, and have seen only a moderate improvement with Kromayer therapy in the milder types with oily seborrhea and comedones. I have also treated a group of cases successfully with alternating roentgen and Kromayer therapy, giving one-fourth skin unit of x ray every other week. Quartz light may also be of some value in reducing the pitting and scarring that remain when a pustular acne has healed.

In acne rosacea I have come to regard the Kromayer light as the treatment of choice. The lesions will rapidly disappear with mild erythema doses, but as I have stated previously unless the gastrointestinal tract and cardiovascular system are carefully regulated recurrences are apt to take place.

6. Diseases of the scalp.

Those of us who have read Nagelschmidt's book on the treatment of diseases of the scalp with quartz light have marveled at his wonderful results in the various forms of alopecia. As the result of my own observations in a good many cases, although admitting that my technic may have been at fault, I am extremely skeptical about the value of ultra violet light in regrowing hair. In the premature and seborrheic varieties the most that I have accomplished is to check the defluvium. I believe that the superior results reported by German observers in premature alopecia are due to the national custom in Germany of wearing the hair cropped close, thus permitting better access of the ultra violet light to the scalp itself. I have very little doubt that my results might have been better if I could have persuaded my patients to have their hair cut short or shaved before each treatment. Wise refers to this form of therapy as a "meditation therapy." On the other hand, in alopecia areata practically all observers are agreed that actinotherapy hastens the regrowth of hair in the bald areas. Its effect is probably merely a local stimulating one. The percentage of cures reported by Fox, Nagelschmidt and Bering is convincing. My own results show about 60 per cent of cures. In patients over 40 the result is doubtful, and in the cases of alopecia areata totalis nothing can be accomplished. In two cases of folliculitis decalvans I have seen the progress of the disease arrested by quartz light treatment.

7. Miscellaneous group.

In pruritus ani and vulvae quartz light therapy gives less relief than the x ray. Varicose

ulcers are said to respond well, and E. L. Oliver has found the light of value in all ulcerative conditions due to impaired circulation. Sampson has stated that ultra violet light will prevent x ray burns from over dosage, but MacKee and Andrews in some carefully controlled experiments have been unable to confirm his observations. I have seen the rapid breaking down of an x ray ulcer after exposure to ultra violet light. Hazen and others have reported the successful removal of x ray and radium telangiectasis by prolonged compression treatment with the Kromayer lamp. Reyn has found concentrated carbon-arc light (Finsen light) of great value in ulceration, atrophy and other cutaneous changes resulting from exposure to the roentgen rays. He finds in contrast to concentrated carbon-arc light that mercury light sometimes has a decidedly harmful effect. In several cases I have found that exposures to mercury vapor light had no noticeable effect on the so-called x ray skin (roentgen atrophy).

In the superficial types of nevus vasculosus (port wine mark) favorable results from compression treatment have been reported by Kromayer, Schuyler Clark, C. A. Simpson, W. A. Clark and others. Butler treated 28 cases and secured fair results in only three. Wise and Eller have treated about 20 cases and obtained satisfactory results in two cases in which the quartz lens could be pressed firmly against the lesion. Wise states that it is necessary to produce a blister to get results. Fox has been discouraged with his results. In the few cases that I have treated regularly I have seen a partial disappearance of the color, but have never secured a perfect result. Wise and Fox have noted improvement in angioma serpiginosum. The treatment of leukoderma with quartz light has been a failure. A few observers have reported favorable effects in scleroderma.

CONCLUSIONS

(1) Ultra violet light is a useful auxiliary agent in the treatment of a variety of cutaneous

disorders, but rarely suffices alone for curative effects.

(2) When properly combined with other remedial agents, the bactericidal and stimulating effects of ultra violet light will prove of value in certain superficial dermatoses, particularly the pyodermias, psoriasis, some forms of eczema, lichen simplex, alopecia areata and acne rosacea.

(3) The penetrating effect of quartz light is valuable in the treatment of cutaneous tuberculosis, but apparently inferior to the action of concentrated carbon-arc light (Finsen light).

(4) The results of treatment in such conditions as lupus erythematosus, nevus vasculosus, acne vulgaris and alopecia prematura in the hands of various observers have been sufficiently variable to justify a conservative estimate of the value of ultra violet light in these diseases.

DISCUSSION

DR. CLARK W. FINNERUD: My experience with ultra violet radiation in dermatology has been essentially the same as that mentioned by the essayist. There is no question about the value of ultra violet radiations in dermatology and there is no question about the fact that by certain groups it is overdone. A large amount of experimental data is still needed, but it is needed from the proper sources. As you know, ultra violet, as with anything in the way of therapy that is beneficial, is used by unlicensed practitioners as well as by regular practitioners. There are many older men in the profession who regard ultra violet radiation very lightly. They give it very little credit in spite of the fact that there are very definite places where it is deserving of a good deal of credit, as was brought out by Dr. Zeisler.

This morning I saw a patient who had a skin disorder which does not respond to ultra violet and I presume he had had ultra violet from his description. He said that he had been treated almost daily for the last three weeks in a Turkish bath.

Another individual whom I saw recently, and it is almost a daily occurrence, complained of a skin eruption which happened to be scabies, and he said he had

had no relief in spite of the fact that the so-called doctor at the health club where he has a workout daily, had given him a good many treatments with what he said was ultra violet light. If it were possible, I should suggest that the lamps, the apparatus be dispensed only to licensed practitioners. I don't suppose that is possible, but I believe that is one reason why so many, particularly of the old practitioners, attach so little weight to ultra violet therapy.

DR. PATTERSON (Cleveland, Ohio): I understood the Doctor to say in his description of the Mayo technic in psoriasis that the patients coming for treatment had the excess of ointment taken off, leaving a film of ointment on. Is that true?

DR. ZEISLER: That is correct.

DR. PATTERSON: Either I am very wrong or the Mayo technic is somewhat wrong. I have been taught and have come to believe if one flea is sitting on the back of another one, you won't kill the second flea because of the penetrability of the actinic ray. I have in fact gone so far as to have my patients bathe before coming for actinic ray treatment because the film of oil or grease which is natural to the skin interferes with the penetrability of the ray itself. I would like to know whether my teaching and practice are wrong. I feel that any ointment that is used following the treatment interferes with the reaction of the actinic rays, therefore, I do not use any ointments of any kind if the patient is coming for regular treatment. If an ointment is used soon after the treatment, the reaction does not occur from four to six hours, and an ointment used before that time interferes with it, or at any time if your patient is coming back in two or three days for a second treatment. Ointments should not be used, as I have been instructed. Am I wrong or is the other technic wrong?

DR. B. H. SHERMAN: Twenty-three years ago after I had finished my college course, the dermatological portion of which was under the tutelage of the essayist's father, I came upon a very troublesome case of acne. It was so troublesome that we didn't know what we would do to get rid of it. After trying all the

time-tried things that I could think of, I took occasion to write to Professor Zeisler in Chicago. I got back a very curt reply from him which I have kept to this day. It was written on a prescription blank. He simply made the statement, "We treat practically all of our cases of acne indurata with the x ray," and signed his name, "Professor Zeisler."

DR. ZEISLER (Closing): I think Dr. Finnerud has brought out a valuable point, that is that the ultra violet light should be given by physicians, and that successful treatment presupposes a correct diagnosis. Furthermore, unless one has a reasonably good working knowledge of dermatologic therapeutics, as you well know, even those of us who are expert in the handling of these cases, will have a great deal of trouble with some of them.

Regarding the Mayo method of treatment of psoriasis, I corresponded with Dr. Goeckerman before I used it and he was very insistent that you should apply the ointment for twenty-four hours and remove it with oil and leave a thin film on the lesion before it was exposed to the quartz light, because he thought there was something in the coal tar that sensitized the skin to the effects of the ultra violet light. I have had patients who have been exposed daily literally for months to ultra violet light with very little effect on their psoriasis. I haven't had any results worth mentioning with the ultra violet light alone, but when it was combined with the use of the coal tar, the results are surprisingly good. Dr. Goeckerman says if they didn't get results in three or four weeks, there is something wrong with their technic. He recommends it up there as the approved method of treatment. It is certainly a lot safer than the x ray, which has to be used with a great deal of caution in the cases of psoriasis because they recur. On the other hand, acne does show a certain percentage of recurrences after x ray treatment, but if the treatment is carefully given, it is still the method of choice, I believe, in the vast majority of cases of acne vulgaris.

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THE PHYSIOLOGICAL ACTION OF LIGHT*

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After reviewing several thousands of pages of literature dealing with various aspects of the problem of the effects of irradiation on physiological reactions, one cannot but be impressed with the great need of more thorough study of the fundamental nature of these reactions, since there is, except in a few respects, far too little agreement as to the nature of the results obtained. While clinical literature is replete with reports of unquestionably good results obtained in various conditions, many of these give little evidence that is of value in formulating a scientific basis for the application of rays in other conditions. In short, most of the applications of phototherapy at present seem to an impartial reviewer to be largely on an empirical basis.

It is the purpose of this paper to discuss certain results, some of which have already been published (1), which, it is hoped, may add something to our small store of accurate scientific information on this subject. It is not necessary here to go into detail concerning the various considerations which lead to the undertaking of this study nor to describe the preliminary experiments.

METHODS

The routine technic employed may be briefly outlined as follows: Radiations were projected from the positive pole of a special carbon lamp fitted with Reyn's carbons and concentrated with a quartz lens of 20-inch focal length so as to give at the point of focus a total spectrum of a little over 4,000 foot candles intensity. Unfortunately, equipment has never been avail-

able for making total energy measurements. The lamp was operated on a 110 volt, D. C. circuit, at 4 amperes. Spectrograms show a rich content of ultra violet energy extending as low as 2,300 Angstrom units.

Dogs under ether anaesthesia have been used almost exclusively. After all routine operative technic was completed, including attachment of a manometer for blood pressure measurement and preparation of the femoral artery for withdrawal of samples of blood, a small quartz tube was inserted in the carotid artery so that the blood flowed through this. Neighboring tissues were protected with thick cotton pads soaked in Ringer solution. In some experiments it was possible to carry on these procedures without clotting in the tube, but in most cases it was necessary to protect against this by means of an intravenous injection of heparin, an organic anticoagulant. So far as can be determined at present this substance has no influence on subsequent reactions *except* prevention of clotting.

After a constant level of anaesthesia was produced the beam from the lamp was projected on the blood flowing through the tube. In all cases a control series was run in which the animals were subjected to all technic *except* irradiation and allowed to lie under anaesthesia for periods comparable to those in the experimental series so that it can be fairly stated that the results obtained were *not due to ether* anaesthesia.

RESULTS

Mean blood pressure: In a control series (Series I) it was found possible to maintain a fairly constant level of blood pressure over periods varying from one and one-half hours to

(1) American Journal of Physiology, Vol. 74, 75, 76, 1925-26.

*Read at fifth annual meeting American College of Physical Therapy, Chicago, Oct. 21, 1926.

two hours, the average depression not exceeding 15 per cent of the initial stabilized level, with a maximum depression of 23 per cent. In series II, consisting of 15 experiments, the blood was irradiated as described above with the result that the average depression was 52 per cent.

Series III consisted of eight experiments in which a glass condensing lens and a glass tube were used so that the spectrum below 3,300 Angstrom units was filtered out. The average depression here was 68 per cent. This suggested another procedure.

In Series IV, seven experiments were undertaken in which the same technic was employed as in Series III except that a gold screen was interposed which would filter out the infra red rays. A corrected spectrogram showed that no rays were present of wave length greater than 7,000 Angstrom units or less than 3,300 Angstrom units. The average depression in blood pressure was 60 per cent. All three of these results are within the limits of the range of variation for each series so that it is questionable whether it is yet possible to attach any significance to the variations among the averages of the various series. It may be mentioned that in no case was there any tendency for pressure to recover after cessation of irradiation.

Rectal temperature was not affected greatly in any experiment, never more than $\frac{1}{4}^{\circ}$ C. A thermometer placed beside the arterial tube never registered more than 30° C.

In many experiments in each experimental series there was produced a degree of shock so profound as to result in the death of the animal even after the anaesthetic had been discontinued. For example, in one instance blood pressure fell in 20 minutes of irradiation from 152 mm., which pressure had been maintained for 15 minutes previously, to 48 mm., or 32 per cent of the initial level. Anaesthesia was now

discontinued. Irradiation was discontinued after 25 minutes, but pressure continued to fall to 22 per cent of the initial level at the end of two hours and ten minutes after beginning irradiation, at which point the animal died.

It is known that blood absorbs rays up to 4,500 Angstrom units with two other narrow absorption bands at 5,450 Angstrom units and 5,750 Angstrom units, so that it is possible that this portion of the spectrum, when absorbed, causes some change in the blood that lowers pressure and in more sensitive animals produces profound shock. At any rate these changes are not entirely due to the shorter ultra violet rays which have, heretofore, been assigned such a large place in the biology of light.

In all experiments with irradiation of any kind coagulation time was decreased more than was the case in ether anaesthesia alone. Electrical conductivity is also affected, but studies on this point are not yet sufficiently complete to justify general conclusions.

Erythrocytes and hemoglobin: Owing to the attention that has been concentrated on the behavior of erythrocytes under irradiation, blood counts were made in both control and experimental series. In all experiments the count was usually slightly higher at the end, but still within the limits of experimental error and was doubtless due to concentration of the blood. The same was true of hemoglobin percentage. There was no pronounced difference between the control and experimental series so that any of the reported changes occurring in these factors, then, must be delayed and therefore due to systemic effects and not to any immediate effect of irradiation.

White cells: There was always a massive decrease in total white count with high relative lymphocytosis, but absolute lymphopenia. The polymorphonuclear leucocytes were, therefore, most easily affected. Counts were made on

samples drawn from various parts of the circulatory system, including the heart. It was not possible to discover any mobilization of these elements anywhere in the circulation so it is possible that actual destruction occurred, though this can only be determined by the intravascular use of supravital stains. This is a problem for further investigation. In control animals the total count was always slightly higher at the end of the experiment than at the beginning, with practically unchanged differential count.

Uric acid: In the course of some of the experiments described above, students in advanced biochemistry were accustomed to secure samples of blood at the end of the experiment to be used in practice determinations of blood uric acid by a modification of the methods of Folin and Benedict. In these samples there were always obtained amounts of uric acid far in excess of the usually determined content of uric acid in dog blood. Since dioxypyphenylalanin, a forerunner of melanin pigment, would respond to the same test, it was decided to investigate this point. Blood samples were drawn before and after irradiation. In a control series samples were taken at the beginning and at the end of comparable periods of anaesthesia. In the control series there was an increase of only 2.7 per cent, which is too small to be of significance and was probably due to concentration of the blood, while in a series of 21 animals irradiated as already described for one and one-half hours there was an increase of 38 per cent. Evidently then, some substance in the blood other than uric acid is markedly increased by direct irradiation of blood *in vivo*. The identification of this substance offers another problem for future investigation. It may bear a direct relation to the problem of photopigmentation.

Electrophoretic potential of red cells: The results of the investigations of electrical conductivity together with the results obtained by others in irradiation of inorganic chemical compounds suggested the investigation of possible

changes in negative potential of red cells resulting from direct irradiation. Expressed in millivolts the average of seven experiments in a control series was 14.43 at the beginning of anaesthesia and 14.17 at the end, while in an experimental series comprising seven experiments these figures were, respectively, 16.12 and 14.82. In the first series the difference is within the range of experimental error. In the latter there is a pronounced reduction in negative electrophoretic potential, the significance of which cannot be stated at present. It is *possibly* due to liberation of negative electrons into the blood under the influence of irradiation.

In order to make the picture as complete as possible blood calcium, sugar and CO₂-combining power have also been investigated. In all cases there was no constant change under direct irradiation that could be assigned to the procedure. In the case of sugar there is no report in the literature that could lead one to expect any change. In the case of calcium no change could reasonably be expected in so short a time. The latter experiments furnish direct confirmatory evidence that any alteration in blood calcium resulting from irradiation is a systemic effect that comes about only after some hours or days. The absence of any constant alteration in CO₂-combining power is further confirmation that irradiation does not, at least constantly or immediately, increase the metabolic rate.

All of these points, will, however, probably be reinvestigated by other methods, unless some other evidence is in the meantime reported by others that will make it unnecessary to do so.

CONCLUSION

Most of the results reported conform fairly well with those reported by others in clinical experience or in other types of experiments. It is believed, however, that these results add still further support to the idea which seems to be now accepted by many investigators that photobiologic effects in higher forms are mediated through the blood.

There are, however, three theories as to how systemic effects are produced by irradiation. In one of these, already mentioned in a paper previously presented by a colleague, it is held that the effects are produced by stimulation of nerve endings in the skin, resulting finally in general stimulation of the autonomic nervous system.

Another theory holds that the rays liberate some substance from superficial cells that acts as a hormone.

The third theory, already mentioned, assumes that rays penetrate to the blood stream and induce changes therein that effect general systemic reactions.

It would not be possible or profitable to attempt to marshal all the evidence in detail that has been advanced in support of these ideas.

Suffice it to say at present that there is no direct neurologic evidence in support of the nervous theory. Furthermore, I have performed numerous experiments in which a depression in blood pressure has been produced by irradiation of the eye in etherized dogs. At first I believed this to be purely a reflex result. However, repetition of the experiments with both vagi and the optic nerves cut in both eyes resulted in similar effects. There was some modification believed to be due to trauma induced by the operation necessary in cutting the optic nerve since these same modifications occurred in control animals. However, the possibility of a minor nervous influence is not entirely ruled out. But the main effect must be assumed for the present to be due to irradiation of blood in the rich retinal capillary bed.

Irradiation of the capillary bed in the pharynx produced the same result. Other investigators have obtained similar results in other regions such as the vagina.

The main support for the nervous theory is found in the results of experiments on penetrat-

ing power of rays in dead human skin. In this connection, however, attention is called to the fact that the penetrating power in living and dead protoplasm is quite different. Macht has found, by inserting a spectroscope beneath the skin of a live dog, that penetration is sufficient to reach capillaries and even larger vessels in and under the skin.

The evidence supporting the theory of photodynamic production of incretions or hormones is mainly speculative and too divergent to permit of detailed discussion here. Much more evidence must be obtained before we can accept or reject this possibility.

In fairness it must be admitted that it is possible and even probable that all three theories may be in part correct. It is a physiological possibility that different subjects may be more responsive by one route than another, which, if true would explain, in part at least, the wide divergence of reported results of the same procedure in the hands of different investigators.

In still another line of my own experiments I have used a gold screen in combination with a fractional spectrum ranging between 3200 and 4500 Angstrom units. Blood pressure was the only factor observed in these experiments and this was greatly depressed. This line of investigation is not yet completed so that it is not possible to give a summarized statement at present.

While the depression in blood pressure is more striking, I do not consider this result of as much significance as some others. The alteration in electrophoretic potential seems to be of much more importance as offering a lead into further fundamental investigations.

Before taking up these considerations, however, I wish to refer to an entirely valid criticism of this work that has been made and which will doubtless occur to many of you. It has already

been shown that these results are not due to ether anaesthesia. It has been suggested, however, that photochemical decomposition of ether in the blood might cause some of the effects noted. Several bits of evidence have been secured on this point although it must be admitted that this is not sufficient to settle the question at present.

A well-known chemist to whom this question was referred states that he does not believe photochemical decomposition of ether will produce any substances that will give these results, but that decomposition by age will produce depressor substances.

To test this point further, fresh ether was exposed in a quartz flask for periods varying from one to eight hours to the light here employed. A dog was now anaesthetized with fresh ether and a blood pressure record taken. While this was in progress an ether bottle containing irradiated ether was substituted. No comparable change in blood pressure resulted in ten such experiments, continuing from one to four hours.

However, final proof can be obtained only by duplicating these results on unanaesthetized animals. Two types of experiments have been undertaken in this direction. In one, dogs were anaesthetized and the quartz tube inserted and arranged so as to extend above the surface of the skin. The animals were then allowed to recover and after several hours, the blood was irradiated as described above.

In the other, all operations were performed with strictly aseptic precautions, the tube was inserted and the blood irradiated. Then the incision was closed after ligation of both ends of the sectioned carotid artery and the animal studied for some days.

Because of the technical difficulties no conclusive results have yet been obtained by either method though the investigation is still under way.

The absence of immediate chemical alteration of the blood indicates that probably we will find the ultimate solution of photophysiology, not in any of the gross changes so far reported by various investigators, but in more obscure physico-chemical or electro-chemical changes. With the exception of the changes in electrophoretic potential reported above and the work of Carl Sonne on thermal changes in the blood reported several years ago, very little has been done in this direction. Unfortunately the author has been handicapped in the further investigation of these phases of the problem by the lack of special precision apparatus and by the lack of means of obtaining it. For some months, however, efforts have been concentrated on the devising of a thermocouple and accessory apparatus for investigating other possible intravascular changes, which will, it is hoped, throw further light on the validity of Sonne's hypothesis.

In addition to this and the problems outlined above, some work has been done on changes in viscosity, fragility of red cells and on electrical conductivity of whole blood, but none of these have progressed to a stage that will justify any conclusions.

Lastly, it is suggested that the use of the quartz tube inserted in an artery offers a good biological test subject for comparing the effects of irradiation from various sources and also those of various portions of the spectrum, for, in spite of the general acceptance of the idea that the only portion of the spectrum that contributes to phototherapeutic effects is the ultra violet, I find myself progressively less inclined to accept this idea as definitely proven.

Rays from any source, if absorbed, will produce physico-chemical changes of detectable magnitude. In surveying the literature I find an increasing accumulation of evidence that there is absorption from other portions of the spectrum, especially by pigmented protoplasm. Too much reliance must not, therefore, be placed in the results obtained by various investigators

working with unpigmented forms, or with pigmented forms not possessing a vascular system.

I regret that it has been necessary in this paper, in spite of several years' work on the general problem, to leave so many points unsettled. My only justification for mentioning so many uncompleted lines of investigation is the hope that others may become interested in investigating some of these points.

DISCUSSION

PROF. ARNO B. LUCKHARDT: Mr. Chairman, Ladies and Gentlemen: I appreciate the courtesy of Dr. Hollender in appointing me as a discussor of this paper, as well as the courtesy of Dr. Reed in informing me that I was so appointed. You will find out presently, however, that my ignorance on the subject is supreme and were it not for the high personal regard I have for Dr. Reed, I should not have even hazarded opening the discussion on the subject.

The most striking result, at any rate it impressed me when I first heard the report of his experimental work on photochemical action of light in the animal, was this enormous drop in blood pressure which followed irradiation of the blood under the conditions he described. I was very dubious about the significance of that result in view of the fact that he had used as an anesthetic in his experiment ether. It just so happened that when these results were first reported I had returned from England where in Dale's laboratory a young man was working on a marked toxic effect of ether that had aged. Like Dr. Reed himself, I came to the possible conclusion that some of this light shock, if you will, which he described, might be due to photochemical changes which had occurred in the ether as the result of the radiation of the blood in the etherized animal. This objection of Dr. Reed is met in part by outlining possible modes of attack to disprove it, but, according to himself, the final answer has not been given whether ether is in part or entirely responsible for these disastrous results. An indirect answer might also be obtained perhaps by using as an anesthetic (the crucial experiment would be in the unanesthetized animal) other anesthetic agents to see if such a profound drop in blood pressure resulting as it often does in death, would occur.

The experiments of irradiating ether prior to administration were necessary, of course, but are not conclusive on the matter, inasmuch as the conditions are not quite comparable in this experiment which was designed as a control. Ether in contact with living cells

and surrounded, for example, by white blood corpuscles and in contact under the influence with other constituents of blood, catalytic agents, if you will, might undergo decomposition, whereas it might not do the same thing when simply irradiated in vitro. These objections Dr. Reed himself has dwelt on at some length and even offered methods for their further solution.

There are several questions that I would like to have him discuss in his answer more thoroughly, especially I think because of my own ignorance. The questions are these: What relation do his experiments bear to the action of sunlight with which we are surrounded? I will dismiss by that statement any possible pharmacological action that limited spectral rays might have and be useful in the treatment of various conditions. I am speaking of the subject solely from a physiological standpoint. In his experiments he has used a limited area of the spectrum and as Sonne himself has shown, the thermal effects, at any rate, of sunlight or limited portions of the spectrum are quite different inasmuch as the whole sunlight among other things causes an increase in temperature at some distance from the skin, some two and one-half centimeters maybe from the surface of the skin, whereas the limited rays, especially those used by Dr. Reed, have marked thermal effects on the surface of the body and on the slope of temperature from the surface to the interior. In other words, effective whole sunlight depends upon a number of factors, such as altitude, humidity, seasons, dust particles in the air, but aside from that if one irradiates physiologically with whole sunlight and determines the effects it has thermally, one could find a marked elevation of temperature as compared with the surface of the skin at some distance below, whereas with ultra violet rays the effect is chiefly on the surface, the parts below being considerably cooler. That might have a deleterious effect or might not be desirable or one might not desire to have the effect.

What I want to know is the relation of his experiments to the physiological action of light as we experience it in nature. The second point is closely akin to it and I would like to have him discuss it also. In his experiments the blood was brought to the surface of the body and directly irradiated. What effects might one expect to have from even this limited area of the spectral field on the body through the protective coatings through which it must possibly pass before it reaches the blood itself, namely, through the skin, mucous membrane or through the dioptric media of the eye? Can one detect in an intact animal changes similar to those which he has described as occurring when the blood is directly radiated?

DR. ALBERT BACHEM: After the thorough discussion that we heard from Professor Luckhardt, I won't have

any questions to ask Dr. Reed. I have to admit that I could not follow everything within such a short time, as I had some difficulty in hearing everything he said. However, it seems to me from his experiments, as well as those which are reported in the general literature, that the different parts of the spectrum produce the different effects upon the organism. There are rays which penetrate through the skin into the deeper layers and these are especially the visible rays and the rays to both sides of the visible part of the spectrum, that means the near ultra violet and the near infra red.

From the literature it must be taken for granted that the far ultra violet does not penetrate sufficiently to reach the blood capillaries or even the nerve fibers. Therefore, I don't think that Dr. Reed's experiments can prove or disprove the theories that I just brought up with a few words in my lecture yesterday. As far as the effect upon the blood pressure is concerned, my impression is, even from Dr. Reed's paper, that especially the visible part will be responsible for this, as if the infra red ray were suppressed and if the far ultra violet rays were absorbed, the effect was approximately, as far as I understood, the same.

Yesterday I mentioned the effect of light upon rickets and upon the erythema in pigmentation reaction of the skin and quoted the well-known experiments from Hess, especially in regard to rickets, and from Hauser and Viale in regard to erythema and pigmentation, and these experiments show that, especially the far ultra violet, or let me say exactly the limit between the near and far ultra violet, around 3,000 Angstrom units, is responsible for these effects. This curve has never been corroborated by newer experiments. So I feel that another experiment is to be made in order to find out how correct the curves of sensitivity of the skin and activity against rickets are.

On the other hand, physical measurements about the absorption of the various parts of the spectrum by the skin date from an older time. As far as I remember, these experiments from Hassenberg date back as far as 1907 or 1913 (I am not sure which) and similarly about the experiments of Hury and Burg and others. I feel these experiments also should be repeated and new experiments should be made. It is my intention to do so, and I am preparing experiments which shall show what the actual absorption of skin is towards the different parts of the spectrum, especially within the ultra violet, and even to measure the absorption of the different constituents of the skin, as for instance, colostrum, which might be important in regard to the question of rickets, blood plasma, as representative of protoplasm and colostrum, and keratin and melanin, for instance. I looked over the literature pretty carefully. I wouldn't say I looked over everything, but I

haven't found any quantitative measurements, so I feel these measurements are absolutely necessary as well as I feel that the experiments are of a very great importance, as Dr. Reed has stated.

DR. REED: The first question that Dr. Luckhardt asked was the relation of these experiments to the action of sunlight. In the first place, in most of the experiments I did use the total carbon spectrum as obtained by some special carbon, the composition of which I do not know. That was sent to me by Dr. Axel Reyn of the Finsen Light Institute. But careful spectrograms made by a competent physicist show that there is a rich ultra violet spectrum extending down to 2,300 Angstrom units. That was the spectrum that was used in most of my experiments. I did modify that in a few instances merely for the observation of blood pressure. I didn't study any of these other factors with these modified spectra.

The one modified spectrum I used had the infra red rays alone cut off. That is, the efficiency of screening was about 95 per cent; about 5 per cent of the infra red rays came through. The second modified spectrum was with the infra red cut off and the short ultra violet rays cut out sharply at about 3,300. The third one was with all infrared cut off and with practically all the visible rays and the shorter ultra violet rays.

DR. BACHEM: In what light?

DR. REED: The longer ultra violet rays. The spectrogram of this glass was sent to me by Chance Bros. in England. They are manufacturers of this glass. The spectrogram shows a curve beginning at about 3110 and running up slowly to about 3275 and then sharply up to 50 per cent of total intensity at 3400, then continues at that point to about 3600 and falls again sharply to 4100. I take no responsibility; as I said, I haven't had any precision apparatus available for total energy measurements in any of these experiments. I can't get it and I don't know whether I will ever have money enough available to get it. That should be done; that is the crucial point of the whole thing if it could be done. Those were the three modified spectra I used only for blood pressure determinations; I didn't take observations on anything else because you realize that is a complicated experiment in which you can't do everything.

The rest of the time these other observations were made with the total carbon spectrum. As to what relation these would bear to the physiological importance of sunlight, I can't predict. If I could, I probably wouldn't go to the trouble to do anything further about it. I can suggest this: I have had several things in mind, not from the beginning, but these ideas have

gradually arisen as I went along. First, just how does light get in to exercise any physiological effect on the body? Irradiation of capillaries in the eye and larynx and direct radiation of the blood gives results which are comparable to results that have been obtained clinically by irradiation of the whole body. That would suggest that in spite of all evidence to the contrary, some effective portion or portions of the spectrum do get through the skin into the blood and do something to the blood that changes its physiological function. Understand I am not accepting that theory as against the others. I merely cite the thing as I see it lined up.

The next question that has been in my mind is this: If it is in the blood, if the blood is the pathway by which this comes about, then what are the changes in the blood? That will simply be a matter of routine, going over the ground routinely and finding out what they are. I mentioned, and I acknowledged all the criticisms that have been made of the use of anesthetized animals. Whatever may be the importance of ether, the comparison of results obtained by this method and by clinical irradiation of the whole body indicate to me that if photochemical decomposition of ether is an important factor, it is of minor importance. I am not going to rule out the other, but I believe I am still convinced that this is a valid procedure for approaching this. The other methods of irradiating animals not under ether anesthesia, induce an enormous number of complications as you will find out if you ever attempt to do it. For instance, in one case a dog proceeded to stick his foot up there and pulled the tube out and bled to death before I could get anything done. Those are some of the complications that come in.

Those are the two main points I have in mind. First, how does the light get into the body to exercise an effect, and, secondly, if it is by way of the blood, what are the changes produced in the blood. I don't believe they are gross changes. I believe they are very obscure changes of a physical, chemical or electrochemical nature. I haven't time to go over all the thing. If you live with the problem a long time you get a lot of things that you can't very well express to anybody else. That is the line that I am going to attack next most intensively.

The possible effect of passage of rays through the tissues. That had never occurred to me, but if we may accept the evidence of the physicists, rays are not modified by passage through a substance beyond the matter of absorption. I think that would be a valid statement, would it not. A ray in passing through a substance is not itself modified.

DR. BACHEM: No; it can be absorbed and produce fluorescence and come out as another radiation.

DR. REED: I mean a ray that actually passes through a substance in itself is not actually modified by that substance. The possibilities of rays being modified by passing through the tissues and exercising some other effect after they get through and absorbed somewhere else, I doubt very much if that is probable. I doubt very much if the possibilities of fluorescence have anything to do with it either.

Now the question of the stimulation of the skin to the cells of the skin, to the production of a hormone, I counted up some time ago and I think there are seven or eight different substances that have been suggested as a hormone produced by the skin. So many of them have been suggested that it is questionable whether any of them are of importance. There may be something else we haven't even thought about yet as a hormone. That possibility is always before us until it is ruled out definitely.

The actual production of a potent hormone, though, by cells not any more highly differentiated than the cells of the skin and subcutaneous tissue, would seem to be a doubtful possibility. I have already discussed those points.

DR. SCOTT (Iowa): Dr. Reed, have you considered the paths from the standpoint of oxidation, What I mean is this: The oxidation processes of the body on which life depends are due to the effect of light upon the body as a cause of oxidation. For instance, I have had the impression that perhaps the eye might be found later to be an organ of internal secretion. That would be sufficient to produce the proper amount of oxidation that is necessary to life. We know that oxidation does not occur without something preceding it. It doesn't in the burning of wood or oil or coal; it doesn't in substance cut off from a source of supply until bacteria breaks it up and it doesn't in the body. Oxidation doesn't take place until something else occurs first and loosens up the molecules. Isn't it possible that the light is the stimulus that results in the oxidation processes to which life is due? Perhaps if we were compelled to look at the sun, the oxidation process would be too great. We get, as it were, polarized light in our eyes. It is just an idea that I had that possibly the eye is a gland of internal secretion producing something that permits the proper amount of oxidation to take place that results in normal life.

DR. REED: Observations made in the Amundsen polar expedition in 1897, in which the large group of men, Europeans, were used to sunlight, showed the men lived for six months in the Arctic night without any discoverable alteration in body metabolism, oxidation or any other process. Grober and Sempl and several others have investigated carefully a large number of

horses in the European coal mines for as long as thirteen years. They were adults when they went in there, of course. How much modification would occur had they been immature subjects is another matter. They were unable to find any gross changes that would indicate any alteration in metabolism, hemoglobin content, red cell count or any of those gross things that are used as indication of internal changes. Further than that I

can't cite any evidence bearing directly on your point.

The fact is there is so much evidence coming up lately indicating that general radiation does not increase the metabolic rate; I don't know whether photo-biologic effects are oxidative or not. I assumed a year ago that they were, but I found so much material since then which bears on that point, and it seems to have been carefully done, that I am doubtful about it now.

THE EFFECT OF DIATHERMY UPON GASTRIC ACIDITY* AN EXPERIMENTAL STUDY

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This is a preliminary report on an experiment undertaken with the purpose of determining the effect of diathermy upon gastric acidity.

The vast number of case reports on the influence of high frequency current on various organs have had, in the majority of instances, as far as we can determine, very few adequate controls.

Whether the favorable results obtained in the majority of these reports were due to the element of time, the psychic influence, or the therapeutic value of diathermy depended almost entirely upon the interpretation of the one reporting the case.

The problem is one upon which we have been working for the last two years. The auto sterilizing mechanism of the upper small intestine was the main stimulus for our work with diathermy.

From our experiments (1) (2) we have advanced our view that it is necessary to have acid buffered material entering the duodenum in order to keep the hydrogen ion concentration ad-

justed to a slight predominance of the acid buffered substances (Ph 5.5-6.3) in the contents of the duodenum and upper jejunum. When the contents of this portion of the small intestine have the above hydrogen ion concentration there is produced by the intestinal mucosa a bactericidal substance that kills all the bacteria in the contents except the obligate flora. When the hydrogen ion concentration is changed to the alkaline side (Ph 7.0 to Ph 8.0) there is a heavy cecal type of flora present in the duodenum and sometimes extending into the stomach.

This latter reaction of the duodenal contents does not take place when the gastric function is normal, i. e. when the stomach secretes enough acid to saturate the buffers to the acid side.

We hoped that with the aid of diathermy we would be able to produce in the dog a condition of complete achylia for a period long enough to verify certain hypotheses that we deduced from our findings.

The great interest shown on the part of the medical profession in diathermy was an additional impetus toward the study undertaken.

*Read at fifth annual meeting American College of Physical Therapy, Chicago, Oct. 21, 1926.

The Fischer portable diathermy machine was used throughout the experiments.

A total of 42 dogs were used, the number of males and females being approximately equal. In selecting the animals the factors of health, size, and disposition were carefully considered.

The dogs had no food sixteen to eighteen hours before the samples of stomach contents were taken. The total and free acidity were determined in each case before exposure to diathermy to determine our normal control for that particular animal.

The dogs were then given a subcutaneous injection of $\frac{1}{4}$ grain morphine sulphate and $\frac{1}{100}$ grain atropin sulphate. An area about four inches wide was then shaven around the abdomen just below the diaphragm.

The dog was anesthetized with ether and another $\frac{1}{8}$ grain morphine given subcutaneously. Usually no more ether was required during the remainder of the experiment.

A heavy coat of shaving soap was applied to a strip of block tin two inches wide and long enough to circumscribe the upper part of the abdomen of the dog. This was closely applied over the shaven area and attached to the indifferent electrode.

The active electrode, consisting of a metallic bulb attached to an insulated cord, was passed into the stomach of the dog.

The temperature within the stomach was taken at the beginning and end of the exposure by passing a thermometer attached to a small stomach tube into the stomach.

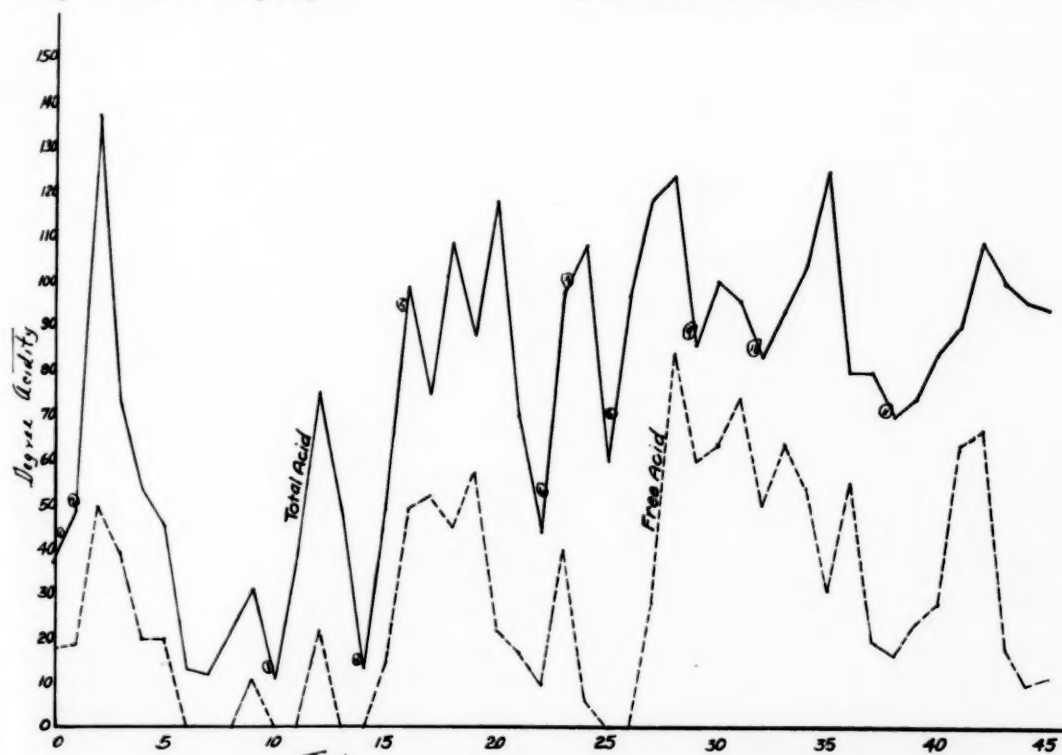


Chart No. 1—Dog No. 66—Normal dog
1, 2, 3, 4—900 ma—30 min.

5, 6, 7—900ma—45 min.
8, 9, 10, 11—600 ma—30 min.

The gastric contents were obtained before exposure to diathermy and subsequently each morning before feeding.

The dogs were kept on the general diet which consisted of meat and bread. The acidity was determined within a few minutes after the stomach contents were obtained by means of a medium sized stomach tube.

No sedative, hypnotic or anesthetic being used while obtaining the gastric contents specimen. Much time was consumed in determining the size of the electrodes, the time of exposure, the voltage, and milliamperage.

Using low voltage it was impossible to raise the temperature within the stomach above 39° C. without causing severe burns and marked edema.

Our results with anterior and posterior plates were quite indefinite. Exposure of long duration was required to effect a marked change in

temperature. By using anterior plate six by six inches and a posterior plate of four by five inches we could raise the temperature within the stomach to 106° F.

In determining the dosage we performed a simple experiment which gave us a slight indication as to amount of current to be used and the duration of exposure. A copper kettle was filled with normal saline solution. Around this vessel a strip of block tin two inches wide was applied. This acted as our indifferent electrode. The active metallic bulb electrode such as was inserted in the stomach of the dogs was placed in the solution within the vessel. By varying the voltage and milliamperage we got the results such as to assume that 900 milliam-

Time	Milliamperes	Voltage	Temperature
30 minutes	500	Medium	38 ° C.
30 minutes	500	Low	38 ° C.
30 minutes	900	Medium	40.5° C.
30 minutes	900	Low	42 ° C.
60 minutes	1500	Medium	48 ° C.
30 minutes	1500	Low	52 ° C.

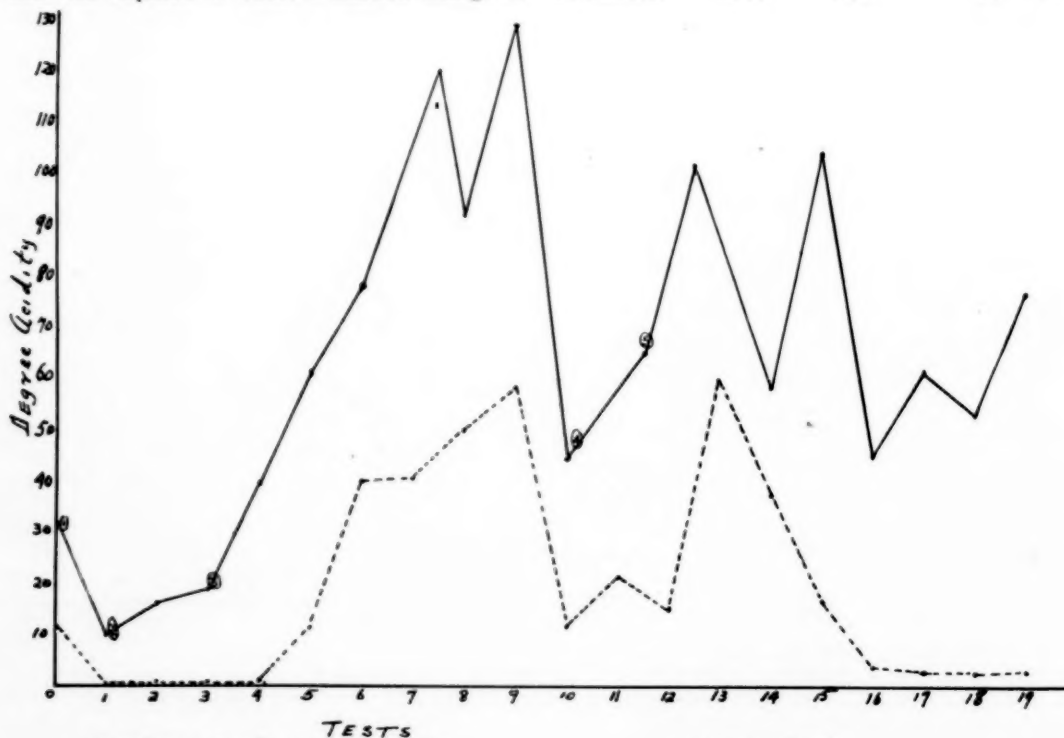


Chart No. 2—Dog No. 77—Normal Dog.
1, 2, 3—900 ma—60 min.

4—500 ma—60 min.
5—600 ma—60 min.

peres medium voltage for sixty minutes might be the proper dosage for our purpose.

We could find no injurious effect on the dog after exposure to diathermy using the stomach electrode and the abdominal band when medium voltage was used. No burns developed when moderate precaution was used in the application of the electrodes. The treatment had no effect whatsoever on the disposition of the animal, providing the milliamperage was kept below 1400. When a greater current than 1500 milliamperes with medium voltage was given the animal seemed to have severe pains.

Autopsies were performed on many dogs and with the exception of slight engorgement of the liver. No gross or microscopic pathology was noticed in any organ.

Low voltage above 500 milliamperes for 30 minutes or more resulted in edema burns and discomfort of the dog for several days. The disposition of the dog often changed after low voltage treatment.

On the fifth or sixth day after exposure as a general rule the appetite of the animal seemed to be stimulated and a concomitant rise in acidity was observed.

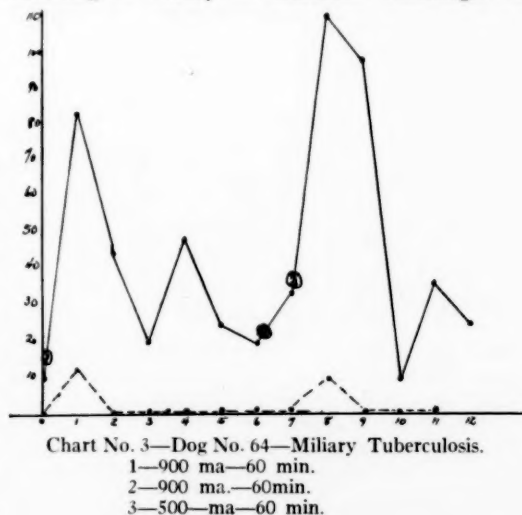
RESULTS

As seen in the typical case of dogs 66 and 77, immediately following the treatment a rise in acidity was noticed. This rise was of short duration. Following this there was a depression in both free and total acid, the duration of this depression being four to seven days. Subsequent to this there was another rise. The period of rise of the acidity and the duration of this rise was found to be directly dependent upon the number of exposures to diathermy. The greater the number of exposures the longer was the period of rise of the acid, especially the free acid, and the shorter was the period of depres-

sion in acidity. From these results it is almost justifiable to assume that by using a sufficient number of exposures eventually a period would be reached where there would be no depression after the exposure and the increase in acidity would be of longer duration. This condition seems to hold true only in the case of healthy animals.

We had three pathologic dogs. One was found on autopsy to have a rare condition among dogs—miliary tuberculosis. Another dog was previously given 150 c. c. 95 per cent alcohol followed immediately 250 c.c. water, which was then removed by stomach tube. The third dog was given 300 c.c. water at 70° per stomach tube, according to the method of Ivy. The last two dogs were prepared in an attempt to produce an achylia. All these three dogs showed upon exposure a slight rise in acidity which was of short duration, and then a reversion to the normal for each particular dog. This may be explained either as due to retention of material after exposure, as stimulation, due to the irritation, or as increase of humeral agent, with the increase in blood supply due to the hyperaemia, as described by Ivy.

Another finding which we are at present checking is worthy of mention. Although we



found this condition only in three instances, the utilization of low milliamperage at medium voltage over a long period tends to produce a steady increase in acidity. The doses used in these dogs were as follows: Initial dose, 200 milliamperes; subsequent treatments, an increase of 100 milliamperes each day until 500 milliamperes were given. There seemed to be a constant rise in the acidity until a definite point was reached.

Further study of these dogs was discontinued temporarily, due to the entrance of disturbing factors in the diet of the dogs.

In view of the above findings it seems to me that we can deduce the following generalities:

1. Subjection of the stomach at frequent intervals to low milliamperage with medium voltage over a long period of time tends to increase gastric acidity, both free and total.

2. In conditions where there is pathology of the gastric mucosa there is an increase in acidity immediately after subjection to diathermy, returning to the normal of that animal within a short period of time.

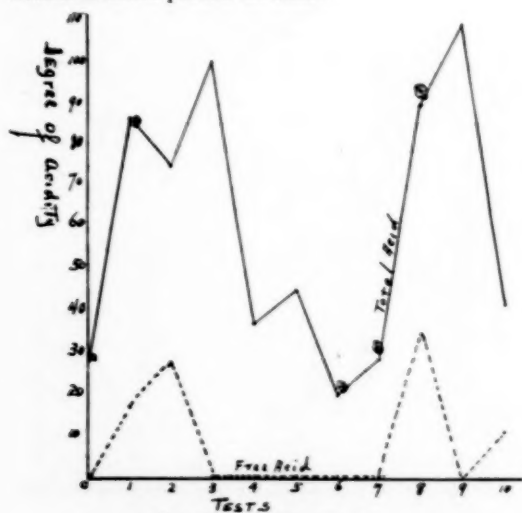


Chart No. 4—Dog No. 49.
Gastric Pathology after Hot Water Experiment
1, 2, 3—500 ma—30 min.
4, 5—500 ma—60 min.

3. Low voltage cannot be used, due to its injurious effect.

4. Higher milliamperage with medium voltage seems to produce a definite picture as far as gastric acidity is concerned. There is immediately upon stimulation a rise in both free and total acidity. This is followed by a period of depression of varying duration and subsequent to this a rise in the acidity. The longer the periods of subjection to diathermy and the shorter the interval between treatments the shorter is the period of depression in acidity.

5. The physiology and underlying theories will be discussed in a future paper when several factors will have been cleared.

6. This almost constant stimulation of gastric function in the normal dog would suggest to us a probable method for the treatment of the

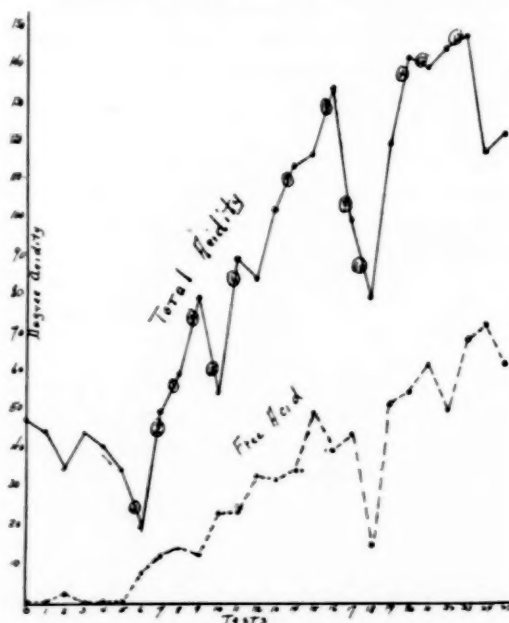


Chart No. 5—Dog No. 72
Low Milliamperage at Frequent Intervals
1—250 ma—30 min.
2—300 ma—30 min.
3—400 ma—30 min.
4—500 ma—30 min.
6, 7, 8, 9, 10, 11, 12, 13—300 ma—30 min.

vast number of gastric achylia of neurogenic or idiopathic origin.

DISCUSSION

DR. NAGELSCHMIDT: I very much appreciated the paper we just heard. It is a very valuable proof of the clinical experience we have had for many years. I have referred in my textbook to several cases of achylia treated by diathermy with good results, and the experiments show we are really able to increase the secretion of the stomach glands just as well as we can that of the other glands. The experiments prove again our clinical experience which is of a valuable character in diseased stomachs. We generally have to treat people who are not only suffering from achylia, but they have other troubles, too. Of course, I have tried to treat some other cases of hyperacidity and other stomach troubles, too. I have been able to see that the results of diathermy treatment were very valuable, and it is the same as in the other case, they are different from the normal, as we have seen in the slides here. If the dogs are not normal, or if abnormal conditions are present in the dogs, they are different.

PROF. A. C. IVY: I think it is work of this kind that is going to put physical therapy upon a very definite basis. You are all observing the practical results on patients of the use of physical therapy, but unless these are backed up by physiological studies, they will be very difficult to interpret from a definite or scientific standpoint. The observations that Dr. Brody has reported this morning are what we might expect from what we know concerning the physiology of gastric secretion and the effect of various abnormal procedures upon the secretory activity of the gastric glands, for example, the depression of gastric secretion by the higher temperatures. We know that when the body temperature, as in fever, rises to 103° F. or above, gastric secretion is abolished. We have had several explanations for this achlorhydria in fevers; one has been the most generally accepted one—that the achlorhydria was due to the toxin that caused the fever. Another explanation is that it is due to the dehydration that occurs with fever, but here in Dr. Brody's work we have forced upon us an explanation which seems to me to be quite probable, and that is that the depression in these high fevers is due to the action of the high temperature *per se* upon the activity of the gastric glands. The stimulation with the lower temperatures, I believe, is best explained by an increase in blood flow through the gastric mucosa. Since we have proven a humoral mechanism for gastric secretion, any increase of blood flow through the gastric glands would increase the supply of humoral agents to them and

thereby we would get an increase in gastric secretion. We would expect this to be more true of the pancreas, however, than of the stomach because the humoral mechanism is more important in bringing about a flow of pancreatic secretion than of gastric secretion. Hence, I believe if these studies of Dr. Brody's were extended to the external secretory activity of the pancreas we would get a greater stimulation than he has observed in the case of the stomach. For example, in the studies of Dr. Orndoff and myself upon the effect of x rays upon glandular activity, we have found that with small doses of x ray you do not stimulate the salivary glands nor the stomach. The minimum effective dose causes a depression of these two organs; but now when we study the pancreas we find that a small dose of x ray, or your 50 per cent of a human erythema dose in the dog, causes a temporary augmentation of the external secretory response of the pancreas to a meal. We interpret this as being due to the increase in blood flow through the pancreas, which in turn is due to the mildly irritating effect of small dose of x ray.

DR. LLOYD ARNOLD (Chicago): Dr. Brody was working in my laboratory on this problem; we started out from purely a scientific standpoint, not interested in diathermy at all. We were looking for some means of influencing physiological function without producing a morphological change. We wanted to have in our hands some method of changing gastric secretory function that was not associated with destruction of the tissue of the mucosa; that was scientifically the problem we were faced with. We tried several methods and all of them failed. We finally decided to try the diathermy method. All the work reported is Dr. Brody's work; he was simply working in my laboratory. The principle involved was the general principle we are all interested in in the laboratory. The results have been rather astounding. We were not looking to find any practical value from our work. We were trying to discover some means of studying, you might say, the bacteria of the intestinal tract.

The practical value of the work is just an example of pursuing a scientific problem along scientific principles. Many times there are leads given from such a problem over toward a practical basis that are invaluable. I think really the work has just started and its ultimate use as an agent for influencing gastric function is still naturally rather experimental.

We realized that from an experimental pathological standpoint we were getting into deep water; we were using an agent there that we were getting more things from than we expected. It really becomes a physiological problem before the experimental pathologist can handle it. We are hoping that Professor Ivy will assist us in this and that it will help direct the problem for

the time being until the physiologist can turn it over to the experimental pathologist in the form he can use it for the original purpose he started out with.

DR. BRÖDY: As far as the electrodes are concerned, we had a two-centimeter electrode made of block tin circumscribing the shaven area just below the diaphragm; that was our indifferent electrode. The active electrode consisted of a metallic bulb which the Fischer people made specially for me. This bulb was of small diameter and was inserted into the stomach by means of a hard insulated cord attached to this bulb. Thus we had one electrode within the stomach and the other electrode circumscribing the upper part of the abdomen.

With reference to a clinical phase of diathermy in relation to gastric acidity, this was merely an experimental study and, as Dr. Arnold mentioned, we had an entirely different purpose in mind when we started this experiment. We tried to produce achylia gastrica. As a result we got a stimulation of gastric secretion. This extreme rise, it seems to me, could be moderated; that is, we don't have to extend the period of exposure for such a long time as we did in this case. Giving small dosage over a period of time, as the last chart seems to show, seems to me would be an indication in the nervous achylia. This was purely an experimental study, and it doubtless has a clinical application.

DIATHERMY AND SURGING SINUSOIDAL CURRENTS IN IMPAIRED SOUND CONDUCTION*

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There is nothing poetic or spectacular in the treatment of impairment of the sound conducting structures of the middle ear. Varied and persistent and studied efforts have been made by learned men to relieve this condition, from which so many, everywhere are sufferers, but the statement can be safely made that, of the generally recognized methods of practice for the relief of impaired sound conduction, no treatment has been better than mildly satisfactory and no procedure has been better than partially successful.

Of the generally accepted means and measures and methods of treatment for middle ear and tubal pathology this paper is making no mention whatsoever.

Nor is any notice taken herein of the other newer forms of treatment such as the sclerolytic x ray treatment as described by Richardson, or the influence of concussive-massage or ultra violet light or other forms of treatment.

It is understood of course, that the generally recognized and dependable procedures are always to be instituted and sanely followed up.

May we state too, that diathermy with all other electrical modalities is to be always regarded as an adjunct to the usual sane and safe and practical forms of treatment which experience and good judgment have proven to be meritorious, and which are taken into account and applied first and always.

To use any electric modality in impaired hearing without having first determined the cause of the impairment and without having ruled out incurable and unimprovable conditions, is no more justifiable than is the removal of a turbinal because it is prominent or the enucleation of an eye because it has been rendered sightless.

Faulty hearing caused by many conditions, among them otosclerosis, Meniere's disease, leukemia, blood toxins, suppurative labyrinthitis, and paralysis of the auditory nerve may be not

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only not benefitted by diathermy, but some of these may under varying conditions, really be made much worse.

The tissues of the middle ear are exactly of the kind to be favorably influenced by localized elevation of temperature, non-inflammatory in type.

Politzer states that "The seat of diseases of the middle ear is in its mucous lining," and further that in the new born this lining is "remarkable for the abundance of its vessels."

Much of the middle ear mischief that we are called upon to treat in young or middle aged sufferers is the continued result of non-suppurative low grade inflammation or congestion of the middle ear during the years of early life.

Were it possible to so effectually remove all the harmful results of non-suppurative middle ear inflammation of childhood during or immediately following the attacks, there would be much less occasion for the varied forms of treatment for loss of hearing in mature or later years.

Because of the great harm resulting from colds, rhinitis, tonsillitis, adenitis and kindred conditions every possible effort should be made to completely clear up all such ailments in the young and all means should be employed to prevent their recurrence. The removal of tonsils and adenoids in those with recurring attacks is practically always justifiable and nasal obstructions in young or middle aged should always receive attention.

It has been well established that in chronic exudative conditions the best results are obtained from diathermy treatments, only when the maximum temperature that can be judiciously applied and comfortably tolerated is attained.

For very evident reasons this would be especially true in catarrhal impairment in the middle

ear, which is essentially a chronic condition, or is prone to become chronic with a tendency towards retrogression of function.

To determine the best means of delivering the maximum of diathermy current to the parts involved in sound conduction impairment, the writer has repeatedly placed the bulb of a slender clinical thermometer well down to the drum head, with the inner half of the meatus filled with a good conducting solution, the bulb of the thermometer resting in this pool of liquid and, during a regular office treatment, has observed the temperature under the various methods recommended for applying diathermy and other currents. I have in this manner repeatedly measured the temperature with both the extra-aural and meatal contacts in circuit as used in our office daily during the last three years.

I have also measured the temperature with the writer's extra-aural contact in use and without the meatal insulated applicator.

Also with the meatal applicator in position without the extra-aural contact.

Also with mesh contact pads over the mastoid, and with block tin substituted for the mesh pads, the indifferent electrode being placed anterior to the opposite ear.

With the amperage running at 400 and with both the extra-aural and meatal electrodes in position as we regularly use them, at the end of twenty minutes the temperature will average 106.5 or 107. It should be stated here that with both the extra-aural and the meatal applicators in position, an amperage above 450 is very likely to produce a transient and somewhat annoying vertigo.

With the meatal rod alone in position the amperage running at about 100 the average temperature of the fluid filling the inner portion of the meatus will reach 106.4 at the end of five minutes and 107 at the end of ten minutes, nor

will there in this instance be any probability of vertigo.

The mesh and the block tin pads were equally effective when applied over the mastoid with the indifferent contact anterior to the opposite auricle.

With this latter method, that is, with the mesh pad over the mastoid and the amperage running at 400, at the end of twenty minutes, the thermometer reading of the fluid in the meatus in an average case was 101.6. The other methods of application need not be taken into account in this article.

The drum head is $1/250$ part of an inch thick. The middle ear containing the impaired sound conduction structures and the impaired mucous lining is about $1/8$ of an inch across.

The bony walls of the middle ear are continued as the walls of the meatus. The membrane which lines the middle ear is continued as the dermal walls of the meatus. Any increase in temperature induced by bi-aural diathermy in the fluid filling the meatus, must register approximately the same temperature in the middle ear.

It is thus seen that the increase above the normal temperature induced at the drum and consequently in the middle ear, is from 50 to 60 per cent greater where the bi-aural apparatus with the meatal application is employed than where the contact is made over the mastoid alone. I have repeated these tests many times and the above are average figures.

The writer in a series of experiments drilled openings from the cerebral cavity down into the middle ears of calves' heads and placed the bulbs of clinical thermometers through these openings into the tympanic cavities. The brain tissue which had been pushed aside was then permitted to fall back about the shafts of the thermometers.

With the excess tissues cut away from about the external meatus, the experiments were conducted with both the extra-aural and the meatal contacts combined and again with the insulated meatal shafts alone in circuit.

With the same amperage employed as is regularly used in office treatments, that is 400 m. a., the temperature in the tympanic cavity advanced at the rate of about one degree per minute until at the end of ten minutes when it had reached 108.

At the same time a thermometer that had been placed into the eustachian tube from the pharynx was found to register 102, and leads to the conclusion that the amperage, at least in part, passes through structures surrounding the eustachean tube.

From all these experiments we determine that the temperature in the middle ear approximates one degree below that of the fluid in the external meatus during the treatments where the insulated meatal shafts and the extra-aural block tin contacts are employed.

As the temperature in the meatus during actual treatments has been found to average between 106 and 107, the temperature in the tympanic cavity should stand near $105\frac{1}{2}$ and 106. This continued for a total of twenty-five minutes should accomplish, we believe, the greatest possible good.

And if Crile's statement is accurate, that a 10 per cent increase in the chemical activity and a $2\frac{1}{2}$ per cent increase in the metabolism, results from each advance of one degree in the temperature, then great effort should be made to deliver to the impaired sound conducting structures the full amperage that may be readily tolerated.

It not infrequently occurs that statements, which have no foundation whatsoever in fact

or in reason are made and continue to be reiterated by speakers and writers until they are accepted at their face.

Into this category falls a statement which has gained credence in presuming to locate the point of maximum temperature attained between two surface diathermy electrodes in circuit on the opposite sides of any conducting structure.

The statement has often been made verbally and has occasionally appeared in print, that the point of maximum temperature between two surface diathermy electrodes in circuit, is located at a point represented by the crossing of two lines drawn from the two margins of one electrode to the opposite margins of the other electrode. No greater fallacy has found its way into the thinking of physical therapy practice than that expressed in this erroneous statement.

There has never been any justification for the statement and it should be forgotten.

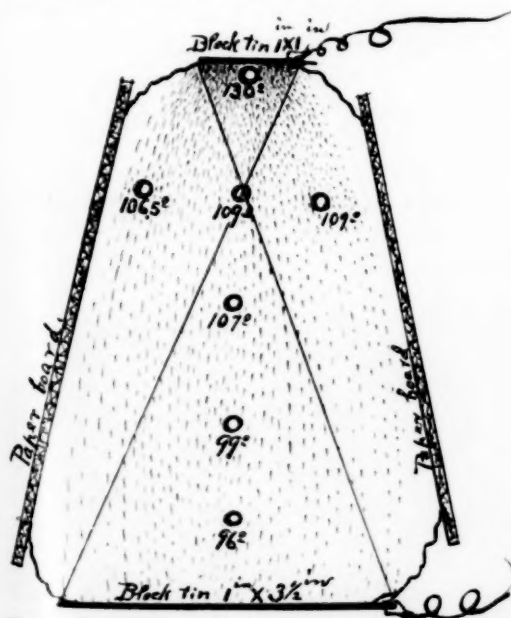


Fig. 1.—Drawing showing method of carrying out experiment on calf brains to determine temperature at various points produced by the application of diathermia. Thermaphone and clinical thermometers used. Current 150 ma. ten minutes.

The writer placed a calf's brains upon a non-conducting surface and pressed the mass in at the sides with non-conducting supports.

At one end of this brain mass was placed a block tin contact one inch square. At the other end was placed a contact of the same material 1 inch wide by $3\frac{1}{2}$ inches long.

The bulb of a thermophore thermometer that would register up to 200 degrees was inserted into the brain mass $\frac{1}{4}$ inch from the smaller block tin contact. Six clinical thermometers were inserted into the mass at points somewhat in the shape of a cross, the head of the cross being toward the smaller contact.

One thermometer was inserted at the point where the two threads passing from opposite ends of the two contacts crossed. Others at regular distances were placed in a line farther from the smaller contact, the last being near the larger electrode.

The amperage was then raised until the mercury in the thermometer inserted where the two threads crossed, stood at 109 degrees. The thermophore thermometer $\frac{1}{4}$ inch from the smaller electrode, at the same instant, registered 130 degrees.

The two thermometers an inch to the right and an inch to the left of where the lines crossed registered 106.5 and 109 degrees, respectively, while those farther from the small contact registered 107 and 99 and the one near the larger electrode 96 degrees.

Similar results have been repeatedly obtained when working with other tissues.

In fact, it may be put down as a law of practice, that when passing a diathermy current through an intervening tissue mass of uniform current resistance, from surface electrodes of different contact areas, the maximum diathermy influence is always developed immediately be-

neath the electrode of minimum contact surface. And the influence developed diminishes proportionately as we recede from the smaller toward the larger electrode.

It is because of these varied and repeated tests, all of which have given identical results, that the writer is firmly convinced that the best results in the treatment of catarrhal impairment of the sound conducting structures, can never be obtained by the use of any appliance which does not deliver, approximately at the drum head, the maximum of diathermy influence that can be comfortably tolerated.

That influence is represented by a temperature of from 105 to 108. And it should be continued for twenty to twenty-five minutes.

I have always followed diathermy middle ear treatments with the surging sinusoidal current for the very evident benefit that must result from electrically and forcibly induced contraction and relaxation of the musculature of the middle ear and the tube.

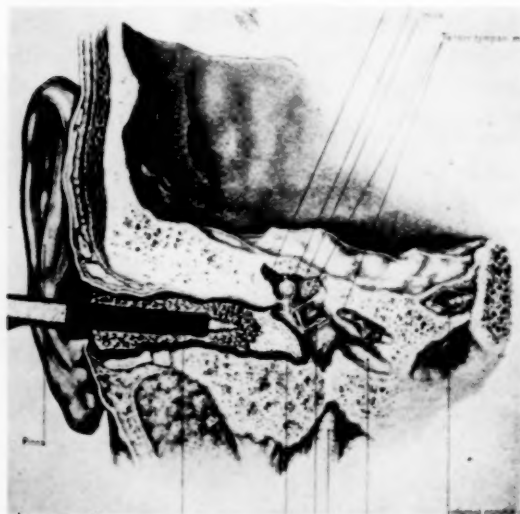


Fig. 2.—Drawing showing method of applying meatal shaft to auditory canal for the application of diathermia to the middle ear. The electrode is insulated with hard rubber except at the tip. Cotton is coiled about the electrode before insertion into the auditory canal.

It is true that the muscles of the tympanum are very small, but it is equally true that they have a very small job. And to induce action in muscles that have been totally inactive or to increase action in those that have been but very slightly active, is to vitalize a function which for a considerable time has been largely inoperative.

The ossicles of the middle ear have joints that are lined with synovial membranes and permit of motion as actual and as controllable as the major joints of the arms and legs.

The movements and the tension of the tympanum and the oscillations of the foot plate of the stirrup in the membrane of the oval window are as essential to hearing as are the movements of the diaphragm essential to normal respiration.

With the external meatus filled with a good conducting fluid and the tip of the insulated meatal electrode resting well down toward the drum head the current flow must exert its maximum of action in the tissues immediately enclosing the middle ear.

In impairment of the sound conducting structures of a catarrhal type the pathology is largely in the middle ear, the eustachian tube being also involved. And it is largely because of the



Fig. 3.—Photograph showing head bands used to hold the electrodes in place, without extra aural contacts and with contacts in position.

marked vascularity of the tympanic membranes that diathermy, deeply applied, brings about favorable results.

We had desired to present a resume of the series of cases treated three years ago, some of which were reported in previous papers, but the time allotted to this paper will not permit.

It may be stated, however, that these cases after being very greatly benefitted or entirely cured have apparently shown no tendency to relapse into or toward their former faulty hearing or their tinnitus. And some of the most striking of these early cases that were benefitted have gone on to practically complete recovery of function.

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DISCUSSION

DR. M. H. COTTLE: The end results of diathermy treatments in various forms of chronic otitis media justifies the time and experimental efforts. We are yet in all that has been said both here and before, in a very empirical state and it is necessary that we come to some definite agreement based on real work as to physics, the physiological action of diathermy.

I am sure that Dr. Linn has had unusual success with his method of treatment because it is in advance of the old, standard orthodox methods of treatment. I am also sure that we with our little technical variations have had similar results.

I don't believe that the point now is, shall you use metal rods or intra oral medication or intra oral diathermy or extra oral alone. Dr. Linn knows, as he has said, that intra oral administration of diathermy alone is not of sufficient quality and quantity to effect very much. We take no issue with that at all.

I want to bring to your attention a few points, especially mentioned also by Dr. Linn. You remember Dr. Linn's diagram of the small electrode and large electrode, a temperature here of 130, the temperature here of 100, and a temperature of 98, and from the location of his threads as they were on his diagram, you see that the maximum effect of the diathermy was in this region. After all, we agree on that. That is in *vitro*, not in

vivo. You have that particular effect depending upon the technique you used in producing the heat. This experiment was done by Nagelschmidt in 1907. I saw him do it two weeks ago.

A dish of albumin (egg albumin or blood substance or any substance that will coagulate) is used. An electrode is placed here and a similar electrode is placed here (indicating), of equal size, measured very accurately with calipers, and diathermy current is turned on, let us say a current of 500. The current is raised to 500 immediately. What happens? Coagulation takes place around the electrodes.

With a lower current so that heating takes longer, let us say with 250, the heating being less, a radiation of heat from the electrodes becomes possible and coagulation no longer takes place at the electrodes, but at a point an equal distance from both electrodes, and the maximum effect, therefore, is where these things cross because they are equal on both sides.

If you use unequal electrodes, you find that coagulation takes place near the small electrode. In other words, we have here a very definite evidence of the necessity of knowing how much current to use, how to turn it on, how long to let it run, and so forth. The point from this experiment shows that you get the greatest heat penetration or the greatest depth of maximum heat effect by using a lower current than you usually would and being unable to reach a high point in no less than nine to twelve minutes, and those of you who have heard Nagelschmidt will remember he makes that a point.

There seems also to be some sort of a physiological threshold. For example, this experiment. I did this very recently. I took a dog and produced a salivary fistula. We placed on the back of the dog's ear the small electrode and in the front a large electrode, and for ten minutes nothing occurred. The saliva from the fistula did not come, and between the ninth and tenth minute a copious flow of saliva from that particular gland occurred. It means that we have a physiological time during which we must gradually stimulate these glands. In other words, we must await the time. Just the production of heat and the measurement of heat is not the criterion in this particular problem. It is perfectly true, as Dr. Linn said, that Crile mentions that you increase the activity of a part 20 or 30 per cent with each degree of temperature. In some cases where you get quick response, response in a week or two weeks, will do almost as well with just a eustachian tube cauterization. The cases that are of long duration will not respond so quickly to diathermy.

There are a great number of problems that have to be definitely worked out in this connection on a physical basis.

*Note—The verbal part of this paper with lantern slides is not reported here.

Another point Dr. Linn mentions about the heat passing through the head, we recall the base of the skull has the parietal bones in this particular direction, the mastoid behind and the external canals here. It is perfectly true it doesn't pass through the base of the brain, perhaps through the lowest stem of the brain. It is not true, Doctor, I think, that you can consider the diathermy current as passing from here to there, and your little area of air in the middle ear is an obstruction in the way of currents produced from the meatus to the meatus.

Try this experiment: In your albumin tube put your two electrodes and introduce a couple of air bubbles and the diathermy current goes right around it and because of the surface offers there an extra resistance and makes the diathermy concentrated at that point. In other words, I believe that your layer of air will produce your greatest heat at the first entrance of the current.

The most important factor in the treatment of real badly impaired hearing that we can't handle very much is not the exact diathermy to the hearing apparatus.

I want to enlarge upon that one point. It is just very recently that Wyeth of New York, I believe, made the statement that we always considered long ago that one of the greatest systemic stimulants, systemic accelerators to the body that we have today at our command is diathermy applied anywhere on the head. This is due to the same reason that salivation is increased when you apply diathermy over the medullary region of a dog. I don't quite agree with Dr. Nagelschmidt that that is due to the action on the medulla which produces an irritation of the gland secretion centers and so forth, because that has never been proven. Nobody has even taken the cordad tympanum and cut it to see whether it is affected through the nerve system. Nobody has ever decided whether there is any heat in the medulla but we do know from experiments that diathermy to the head in sufficient quantity does raise the temperature of the brain, but it raises the temperature of the brain a very slight degree and that slight degree seems to be adequate. In other words, if we have a circle representing the skull and we have a thick bone layer over which are muscles and tissues, and then we have a space, a fluid space, if you please, a circulating fluid space, and this between two layers of dura, and then we have the brain which is a blood filled organ with lymphatic fluid continuously carrying off the heat produced.

Dr. Linn is familiar with the fact that we measured that on the living dog and not on the dead dog and checked it very carefully. We know that you can with moderate degrees of diathermy produce a rise of temperature in the brain not to be compared with the tem-

perature produced around the electrodes, but it is a slight degree of temperature; let us say a degree or two. But that is physiologically sufficient because that temperature which is produced is not a general systemic temperature. That we prove by measuring the body temperature, one thermometer in the peritoneum and one in the bowels, the thermometer being shoved in surgically without infection and sealed with collodion and so forth.

So we must remember that the last word is not finished. We believe that we get a sufficient rise in temperature to know we are dealing with an actual heat (Dr. Linn agrees with that), and we know that we do get a rise in temperature in the brain, but a slow and small rising temperature, so that diathermy applied over the mastoid region or in the ears makes very little difference, I believe, in the bad cases.

We must not forget the general systemic infection produced by raising the brain temperature a slight amount. I think that Dr. Linn has done a lot of work in stimulating our interest in this particular problem. He is perhaps the first real pioneer in America on this work, and I am always glad to have the opportunity to argue with him and to agree with him and to express my appreciation for having heard a well worthwhile paper.

DR. WM. A. LURIE: I regret that I can't discuss the paper as intelligently as Dr. Cottle and perhaps some others of you. I believe you have heard quite enough from me, but I think what Dr. Cottle refers to in his last remark is a little device I showed him that I have developed, and that I believe reaches, in giving diathermy of the head, the upper head passages and also the ear a little more definitely than we have been able to reach.

I didn't come prepared to describe this or to give it in any manner, but since Dr. Cottle mentioned it (I wanted to submit it to him first and since he has mentioned it), I will describe it here.

In my work, more particularly about the mouth, it became necessary to treat pyorrhea with diathermy and I found it impossible in using high frequency current to always be above the gum margin where heating is more simple and less painful. The minute you touch a vital tooth, your patient has pain. It is hard to hold electrodes up above the gingival margin to give a thorough heating such as might be of benefit to a patient with infected jaw or pyorrhea.

With that problem in mind, I devised a little electrode which I have used quite successfully and I find that I can develop a temperature over the entire mouth

if I want to, or further back in the air passages in the ear, that the range will be well over 105 to 110 and 112 in some instances, according to the current and time of treatment.

This is a little device of vulcanized plate form that the patient can bite on and the metal electrodes make a contact with the machine. The caution first is that a little block tin or preferable, tin foil, be put high up in the jaws behind the gum margin or in the lower jaw so that it does not touch the teeth, and these are brought into contact. The frame is adaptable so it can be adjusted to any size of mouth.

You make the diathermy connection through the head band, the base of the neck, or determine the position that you want the current to be directed into.

DR. EDMONDSON: How does he tell the condition of the bone? Is it just a clinical presentation?

DR. A. L. JUDD: I have been using Dr. Linn's method. I wish to have him explain it to some who have not used the method to show you gentlemen some misconceptions some people have.

CHAIRMAN COTTE: Lots of you people have been using this particular form of treatment and I think it is only right that you should say what your experience has been.

DR. POOS: I have been using the Hollender-Cottle electrode with the head band and so on. In combination after the use of the head band as generally used, I have the patients put their fingers in their ears, holding the two cords and in that way heat up the oral canal. After that I pass some diathermy through the nose, at the same time trying to get the added effect of heating up the eustachian tube, and in combination give them the body radiations with the ultra violet Alpine light and also the heat.

I think by combining all those various factors besides the orthodox treatments, it would be a little more to our advantage in certain cases.

DR. ARTHUR E. SCHILLER: I would like to ask Dr. Linn if he considers that x ray treatment is indicated in giving the diathermy treatment.

DR. HALERT A. HAYNES: I would like to ask Dr. Linn if he treats both ears at the same time equally well.

DR. LINN: I always treat both ears unless there is a well ear on the opposite side, but for this purpose the usual situation is that you have both ears involved. You can place a larger electrode here and treat only the one ear, but usually there is impairment in both ears, not evenly so, but similarly; so both ears are treated at the same time.

As to the x ray treatment being contraindicated, it ought to be helpful if it can be skillfully applied. It seems to me the novice should never fool with these ears. Dr. Richardson and Dr. Denman have done a very great deal of work in that line.

As to the diagnosis of otosclerosis, that is in all the books. Of course, otosclerosis being treated by this or other means has never yet been improved other than in a very mild way, although there is some wonderful work being done on that and at some time it may be possible to benefit it.

As to the placing of the fingers in the ears. I think that is altogether valueless because of no merit whatsoever and should never be depended upon. It is all right to play with that, but I can't conceive its having any merit.

As to taking off and putting on of the electrode, the cord, of course, is slipped in here. I always slip it off and slip the cord back in. I do it in a moment. This holds the electrode in position. Of course, you understand the current is cut off. No one who works with diathermy is going to play with the electrodes while the current is running. It would produce a spark and the patient would tell you about it. You throw your machine off, turn the cord off, slip it off and then turn your machine up to about 100.

In the first turning on of the current, we very rarely throw the current on to 400. In some chronic cases we do it purposely, but usually we put on the current to the amount of 250, then raise it to 400, 450 or 500, but you watch it very carefully if it gets to that because it may cause vertigo and patients do not like it. You should always have a time clock at hand and a bell at hand so that if the patient wants to call your attention, he can strike a bell. Do not count on their yelling to be heard all over the office, because that jars other people. There are always two timing clocks so that I set one for one patient and the other for the second patient, if I am using two people.

As to the crossed lines, in this particular instance which I illustrated here a moment ago, the temperature was turned on at 100 and ran maybe about five minutes. Then it was raised to 250, then 400. I have usually followed that method in the tests I have made. I never would want to raise the temperature so there would be coagulation. I have never seen a deviation from that result. I am thoroughly convinced my method is somewhere near right, but men more able than I am say I am wrong.

There should be no greater temperature near one ear or the other and somewhere towards the middle may be the maximum. Thank you.

THE VALUE OF ARTIFICIAL HELIOTHERAPY IN PULMONARY TUBERCULOSIS*

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Since the epochal work of Rollier, begun at Leysen, Switzerland, in 1903, so definitely proved the effectiveness of (natural) heliotherapy in extra-pulmonary forms of tuberculosis, the method has been almost universally accepted as an essential element, if treatment of these forms of the disease shall be considered adequate. But in the strictly pulmonary forms of tuberculosis we have been led to believe that heliotherapy, natural or artificial, is of little, if any, value—and limited to improvement of the patient's general condition without effect upon more recent experience indicates that this hypothesis is without foundation in fact and that properly used in carefully selected cases of pulmonary tuberculosis, amenable to ANY sort of treatment, heliotherapy not only improves the patient's general condition without effect upon the diseased pulmonary tissue. However, our favorable effect upon the pulmonary lesion *per se*. In this "paper" we shall discuss both the local and general effects of a favorable nature following the use of ARTIFICIAL heliotherapy in the treatment of pulmonary tuberculosis, based entirely upon the experience of the author or his intimate knowledge of the experience of those with whom he has been associated. The most outstanding of these beneficial local effects noted as the result of the use of heliotherapy in pulmonary tuberculosis, is the marked and rapid decrease of lung "moisture"—"rales" constantly present at oft repeated examinations prior to the institution of this method of treatment frequently "clear up" in a surprisingly short time after treatment is begun. The effect upon expectoration is interesting in that while the amount in twenty-four hours is decreased, especially marked at the times when it had been

most copious—i. e. in the early morning—during and for an hour or two after each period of insolation the amount of expectoration is increased, but it is thinner, looser, and can be raised without the exhaustive effort which marked the raising of sputum before treatment with heliotherapy was instituted. Patients themselves note this effect and not infrequently remark: "I raise a good deal during and just after my 'sun' treatment, but it is loose and comes up easily." "I do not have to cough until exhausted to raise a small amount of sputum." Connective tissue healing of the tuberculous focus is stimulated and hastened as can be shown by x ray films of the chest taken at intervals after the patient has been under treatment, compared serially and with those taken prior to the use of heliotherapy. In one case in the experience of the author this increase in fibrous tissue was most remarkable and before treatment was begun, in spite of absolute rest in bed for a prolonged period and strict sanatorium regime, this patient showed little or no evidence of fibrosis. Artificial heliotherapy appears to have an analgesic effect, a number of our patients reporting painful pleurisies relieved by, or at least during, their periods of insolation. The phagocytic power of the leucocytes is increased with absorption of bacilli and the products of necrosis. The red blood cells and the hemoglobin content of these cells is increased, in one of our cases hemoglobin percentage increased from 55 per cent to 95 per cent in less than three months after beginning artificial heliotherapy, without medication and without other treatment except rest and the usual sanatorium regime of the ambulant patient. In pleurisy with effusion absorption and healing is hastened by the use of artificial heliotherapy. The functions of the skin

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are improved, its pallor and dryness are replaced usually by a healthy bronzing and by a velvety feel to the touch. Muscular tone is increased despite the fact that the patient is probably getting but little exercise. This effect is less marked than in natural heliotherapy in which it is so marked Rollier speaks of the sun as a "massuer." The fact that this effect of artificial heliotherapy is less marked than is seen in natural heliotherapy is possibly because much of the effect in cases treated with natural heliotherapy is due to the fact that the patient is at the same time getting an air bath which is not so in treatment with artificial heliotherapy administered within the four walls of a physiotherapy treatment room.

Among the more general effects of artificial heliotherapy noted in our cases may be mentioned lessening or disappearance of cough. In more than half of our cases the cough either completely ceased or became so much lessened it was no longer an annoyance. In no case was cough reported increased by treatment with artificial heliotherapy. The effect upon pulse rate result. More than half of our cases showed an increase of both systolic and diastolic blood pressure, an increase averaging 10 mm. Hg. of both systolic and diastolic, the pulse pressure remaining unchanged. Coagulation time of blood is apparently lessened for some time after treatment with artificial heliotherapy has been administered. The value of this will be apparent. The fear has been expressed that heliotherapy tends to increase the tendency to hemorrhage, but in our experience this has not been the case for in no instance has it been possible to attribute hemorrhage or blood streaked sputum to the action of artificial heliotherapy. A history of blood streaked sputum or even frank hemorrhage is not considered a contra-indication *per se* to the use of this modality in the treatment of pulmonary tuberculosis. Heliotherapy (artificial) has been begun in from two to eight days after the patient had blood streaked sputum or hemorrhage without recurrence of the bleeding in any case. Patients as a rule sleep better after treatment with artifi-

cial heliotherapy than they did before, many who had been very poor sleepers finding themselves able to sleep readily both at night and during the daylight "rest hours," often sleeping during the period of treatment. Appetite and digestion, if affected at all, are improved; in no case has any unfavorable effect upon appetite or digestion followed the use of artificial heliotherapy. The increased tendency of patients with pulmonary tuberculosis to "catch cold" is well known. We have noted a lessening of this tendency among patients treated with artificial heliotherapy, just as this increased susceptibility to the "common cold" is so markedly diminished by treatment with natural heliotherapy. The charge has been made that heliotherapy tends to increase the nervousness of the tuberculous. In our experience the contrary has been true; patients treated with artificial heliotherapy in whom nervousness was an outstanding and annoying symptom become distinctly less nervous after treatment was instituted. This effect was of special value in female patients in whom nervousness hindered their recovery in no small measure and caused us much concern. No prolonged headaches, dizziness, vertigo or other untoward symptoms referable to the nervous system presented which could be attributed to heliotherapy. The psychic reaction is usually one of optimism, the patients feeling that now something is really being done for them, something more potent than merely keeping them quiet in bed, that now they are receiving treatment based upon scientific principles and as a result they will be sure to get well. Anyone at all familiar with the disease (pulmonary tuberculosis) will know the importance of the psychic side of treatment and will appreciate how valuable is this effect of heliotherapy, especially the artificial form, for in this the apparatus is impressive and inspires within them new hope of recovery. If heliotherapy had nothing to commend it save this favorable psychic effect, this alone would justify its use. Most of our cases gained weight commensurate with their improvement in other ways, weight due to the increased musculature already mentioned and

accompanied with an equivalent increase in strength, not the mere deposition within the tissues of a lot of useless fat.

In the foregoing we have attempted to epitomize as briefly as possible the more important of the favorable effects following the use of artificial heliotherapy in pulmonary tuberculosis, effects which establish the value of this method of treatment in this disease.

In order to secure the best results from treatment of pulmonary tuberculosis with artificial heliotherapy it is important that the technic be as nearly perfect as possible—that patients be carefully selected from the standpoint of their suitability to be so treated, that evidences of untoward effect be closely watched for and if any such evidence presents, that the treatment be discontinued or the dosage modified as to length of time, time of day given, etc., as may be necessary. It will be obvious from the above statements that this treatment must be prescribed and supervised by a physician, one specially qualified by training and experience to do so—it cannot be left to the office girl, to a technician or an orderly. The original technic of Rollier outlines for use in treatment with natural heliotherapy is of equal value in artificial heliotherapy and cannot be improved upon. In our work this technic has been closely adhered to. Briefly this technic is as follows: On the first day only the feet and ankles are exposed for a period of five minutes, this to be repeated three times during the day. On the second day feet and ankles are exposed ten minutes, legs to knees five minutes, the remainder of the body being covered. This is repeated twice during the second day. The third day feet and ankles are exposed fifteen minutes, legs to knees ten minutes, thighs to hips five minutes, the remainder of the body being protected. Thus the length of exposure is increased and the area exposed extends by daily gradations until by the sixteenth day the entire body is being exposed 60 minutes front and back, the full treatment requiring two hours. This is

considered maximum and no further increase is made. The face and head are always protected, the eyes shielded with amber or blue goggles. It will be noted that the chest, the portion of the body in which primarily interested in treating is the last to be exposed. Those familiar with the physics of quartz light reactions advise that best results are obtained when the lamp is 40 inches above the patient. This statement I am unable to confirm or contradict, but in our work we have the lamp as nearly an even 40 inches above the patient as is possible.

Rollier advises the use of the early morning and late afternoon hours in treating patients with natural heliotherapy. Artificial heliotherapy can be used with as good effect at one time as another. The degree of skin pigmentation is considered by some as the index to the success of the treatment. That this is not a fact is indicated by the good results obtained in the treatment of blondes and those with red hair who even at the end of treatment are scarcely tanned.

As to the type of pulmonary case suitable for this treatment there is much divergence of opinion. Some hold it should be used only in those cases in which progress toward recovery is at a standstill, the case little if at all "active," much as we at one time used tuberculin and the auto-inoculation (by graduated exercise) method of Patterson, others that it can only be used with safety in that very mild type of the disease in which recovery follows without much effort on the part of either physician or patient, still others that it is indicated in all pulmonary cases except those with very active, progressive lesions or those with profound constitutional reactions. Somewhere between these extremes lies the type or types of case most suitable for treatment with heliotherapy, but the method is as yet too new for us to definitely state the type or types in which it is indicated. With increased experience will naturally come increased knowledge. Certainly it should not be used in pulmonary cases with "activity" manifested by febrile reaction and should be limited to fibrous and nodose

cases with little or no "activity" clinically and showing little or no "perifocal reaction" on the x ray film. But in any fibrous or nodose case without much febrile reaction, with little or no perifocal reaction and without certain complications such as arteriosclerosis, decompensated cardiac disease, and arterial hypertension it is a method of distinct value and worthy of our serious consideration. In other words, in uncomplicated chronic pulmonary tuberculosis artificial heliotherapy is a method of treatment of definite value.

We are forced to admit that heliotherapy, natural or artificial, is not so effective in pulmonary as in extra-pulmonary types of tuberculosis, but there are several reasons for this and these should be kept in mind, and one should not expect as good results in pulmonary as in extra-pulmonary tuberculosis. Some of the reasons why we get better results from heliotherapy in extra-pulmonary than in pulmonary tuberculosis are as follows:

1. Pulmonary tuberculosis is less amenable to all forms of treatment than is the extra-pulmonary type.

2. Immobilization of the lungs is more difficult and never so complete as is possible with bones, joints, etc.

3. Because of their structure the lungs are naturally less resistant to the tubercle bacillus than other organs and tissues.

4. The lesions in pulmonary tuberculosis are deep seated, at unequal distances from the surface and vary in their density, structure, etc., so that what is just enough exposure at one place may be insufficient in some other area or may over-exposure still another area.

5. Finally, to be successful in the treatment of pulmonary tuberculosis by means of artificial heliotherapy as by any other method, requires more conscientious effort, more patience and more skill on the part of the physician and more complete and faithful co-operation on the part

of the patient than in any other type of the disease. Heliotherapy, natural and artificial, all too frequently fails of success because one or both of these essentials are lacking. This is a test of the stamina of both physician and patient.

CONCLUSIONS

1. Clinical experience and scientific research prove that, used in suitable cases, artificial heliotherapy is of definite value in the treatment of pulmonary tuberculosis, its use should be encouraged and its effects made the subject of our serious study.

2. The most outstanding of the favorable effects upon these pulmonary cases is the marked decrease in lung moisture.

3. Properly administered artificial heliotherapy does not produce or predispose to hemorrhage, unfavorable psychic reaction or functional nervous disease.

4. Artificial heliotherapy can be used safely, usually to advantage, in any fibrous or nodose pulmonary lesion with little or no "activity" (febrile reaction, etc.), with little or no perifocal reaction (x ray) and not complicated by arteriosclerosis, hypertension or uncompensated cardiac disease (organic).

5. Artificial heliotherapy has distinct advantages over natural heliotherapy among which are that it is available in all localities regardless of climatic conditions at all seasons of the year, in all sorts of weather and can be used as advantageously at one time of day as another. Further, the dosage can be the more accurately measured and better controlled than is possible with natural heliotherapy.

6. And most important of all, to be of most value, to be safely and successfully used in the treatment of pulmonary tuberculosis artificial heliotherapy must be prescribed and supervised by a physician specially qualified by training and experience to assume this responsibility.

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AUTOCONDENSATION THERAPY*

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For the purpose of a better understanding of autocondensation let us briefly review the fundamental principles governing a high frequency current.

It is well known that during the passage of an electric current through a bar of iron, the medium surrounding the iron bar is in a state of stress. The space so influenced is known as an electromagnetic field which consists of lines of force of almost infinite number and extent; however, the appreciable effects are limited to a small area. We are aware, also, that an electrified body when not visibly connected to them will cause electrical disturbance in other bodies in its immediate vicinity, and the process by which this disturbance takes place is called induction. The intensity of the induced force depends upon the ratio the original or primary force bears to the induced or secondary force, also upon the rate of change and voltage impressed upon the primary or original source.

The requisites of a high frequency current for medical purposes are: a source of supply of the alternating current, a step-up transformer, a condenser, a spark gap and an inductance coil.

A condenser is a device by which electrical energy is stored and its ability to do this is called capacity. A condenser may consist of leyden jars or a number of sheets of tin foil or other metal separated by dielectrics of glass or mica. The metal sheets of each alternate layer on either side are connected together and to which the wires coming from the secondary of the transformer are attached. The condenser acts as a reservoir for the current which stores up as a charge on the plates until the tension of

the dielectrics becomes so great that the current discharges across the gap. The discharge across the gap consists of oscillations of decreasing amplitude similar to the decrement in the oscillations of a pendulum from its maximum amplitude until it comes at rest. During the time of discharge across the gap the condenser is collecting a new supply from the transformer and inductance coil ready to renew the charge.

The physiologic and therapeutic effects of auto-condensation differ materially from those of any other form of application of the high frequency current. In no other method does the patient form a part of the high frequency apparatus. In other words, he is one plate of an accessory condenser, the couch mattress corresponding to the glass of the leyden jar, the metal plate underneath the mattress to the inner coating and the patient to the outer coating of the jar.

The current enters the couch plate and by induction sets up a current in the body of the patient, the current finding its way back to the machine through a conductor attached to an electrode held in the patient's hands. This arrangement condenses electricity in the mattress in the same manner as in the dielectric of a jar or plate condenser. The patient, being the other plate of the condenser, receives the current to the point of saturation in the same manner as the plate of the condenser, the only difference being in the manner of the discharge. There being no accessory spark gap, the discharge takes place coincident with that of the condenser of the machine.

It is a well-known principle of electro-physics that the higher the voltage of current supply the wider the extension of lines of force from a

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charged body and that the lines of force concentrate as they approach a charged body; therefore, it is easy to understand that that part of the patient's body in contact with the mattress will receive many more lines of force than that part of the body distant therefrom. In other words, the current heaps up in that part of the body which comes in contact with the dielectric, and the lines of force become farther apart as the distance increases from the mattress.

This principle of electro-physics explains the difference between the effects of autocondensation on a thin lightweight and a heavyweight patient. It also explains the difficulty of obtaining autocondensation effects with a thick couch pad and an inadequate apparatus.

During autocondensation the body of the patient undergoes thousands of charges of electricity per second to which the beneficial results are due. No such effects are produced by direct diathermy.

There is much in vogue a method of applying a combination of diathermy and autocondensation and which is called autocondensation. In this method in lieu of the electrode being held in the hands of the patient, a large electrode is placed on the patient's chest, abdomen or both. A large area of electrode surface is provided and from which the current finds its way back to the machine over a much easier route; the discharge, as it were, leaks off and fails to give to the patient the benefit of the sudden discharge of a large quantity of current from a small area which would result were the small electrode held in the patient's hands. By this method the heat effects are much greater and blood pressure will be reduced; however, the effects upon the vasomotor nervous system are reduced, thus lessening the permanent effects of autocondensation.

The effects of autocondensation are: increased tissue changes through increased oxidation; elimination of waste products in the urine due

to a more complete oxidation of nitrogenous matter in the body; elimination of carbon dioxide and rapid elimination of toxins; increased oxygen carrying power of the blood; increased hemoglobin content of the blood.

These effects are partially due to heat, but principally to the action of the current upon the sympathetic nerves controlling secretory and peristaltic functions. There is a general soothing effect upon all painful conditions. Some patients experience a drowsy sensation on coming from the autocondensation couch, while others feel exhilarated. In either case it is advisable to administer laxatives between treatments to avoid ill effects of liberated toxins. In cases of defective metabolism there is always an increased oxidation evidenced by an increased amount of urea in the urine and a decrement of nitrogenous products in the blood.

Autocondensation increases the body temperature. During an ordinary treatment (400-600 milliamperes) for a period of twelve minutes the rise in the body temperature seldom exceeds 1/5 degree F. Continuing the treatment for a long period of time may raise the temperature from 1/2 to 1 degree F.

LOCAL AUTOCONDENSATION

Local autocondensation is a modified form of autocondensation in which the usual hand electrode is displaced by a metal plate, a non-vacuum electrode or fingers of the operator. To secure maximum results from this method the electrode is applied to the patient with rubber, glass or other dielectric interposing. The object of this method of application is the concentration of a large quantity of current at some point of small area. It is more or less useful in relieving pain and stimulating glandular tissue. It is valuable when the combined effects of autocondensation and local hyperemia are desired. Local autocondensation is sometimes called indirect diathermy.

AUTOCONDENSATION FACTORS

Autocondensation factors are: (1) type of current; (2) dielectric, thin or thick; (3) voltage; (4) amperage; (5) frequency of current oscillations; (6) time.

A proper correlation of autocondensation factors is necessary to maximum results.

Type of Current. The so-called Tesla current is one of high voltage and correspondingly low amperage. Practically all high frequency machines are equipped with Tesla coils. The Tesla current is extremely valuable in autocondensation on account of the high voltage and its power to assist in the elimination of toxic substances. The so-called d'Arsonval current is one of moderate voltage and correspondingly high amperage. The d'Arsonval is of the solenoid type. Few high frequency machines are equipped with this type of coil. However, practically all high frequency machines are so constructed that a lower voltage and higher amperage current is available. The d'Arsonval type of current is a desirable one in the treatment of some forms of high blood pressure, especially when profound effects upon metabolism are desired.

It is quite probable that the indications for the use of the Tesla current in autocondensation are 25 times greater than those for the use of the d'Arsonval current.

Dielectric. A thin dielectric consists of a plate of tin foil or other metal covered with a thin layer of indurated fiber and constructed in two pieces hinged together to form a seat and back of a chair. This form of chair pad is very convenient and for this reason is probably most frequently used in autocondensation.

A thick dielectric consists of a metal plate about six feet in length covered with a thick mattress called a couch pad. This form of dielectric has a greater capacity and requires a current of greater voltage to charge it than does

the chair pad dielectric. For this reason the low voltage and high amperage current secured by tappings of the Tesla coil fails to properly charge the thick dielectric, consequently, to secure an adequate charge in the patient, a thin dielectric must be used. However, a current from a properly constructed solenoid is of a potential sufficiently high to charge a thick dielectric.

With a patient on a thick dielectric extending the entire length of the body, the current is more evenly distributed; hence, deeper conservative heat effects are obtained, thus producing more profound metabolic changes. With a thin dielectric the current, as it were, is heaped up at the point of contact with the patient. Concentration of current in the patient's shoulders and gluteal muscles as well as discharges which excite reflexes are common in chair pad treatments.

While the thin dielectric fulfills certain indications for general use the thick dielectric is of supreme importance in the treatment of high arterial tension.

Voltage. In all cases where a thick dielectric is used a moderately high voltage is essential to charge the dielectric. A peak voltage of about 15,000 seems to fulfill the requirements as effectively as a current of higher voltage.

Amperage. It is the belief of the writer that when autocondensation is used to reduce blood pressure low amperage should be the rule. A current quantity exceeding 600 milliamperes is seldom called for. Amperages from 300 to 500 seem to be most effectual.

The correct measurement of the intensity of high frequency currents is a difficult matter. A reading of 300 on one meter may equal a reading of 500 on some other meter. When the patient complains of aching in the wrists the dosage is too high, regardless of the meter reading.

Frequency. In the treatment of high arterial tension, high, medium and low frequencies are quite essential, the high being preferred in cases of arteriosclerosis of long standing when skin effects are desirable, the medium in milder forms of arteriosclerosis and the low when deep conservative heat effects are desired.

Time. Time is an essential factor in autocondensation. In the treatment of high blood pressure the tendency is to prolong the treatment. Aching in the wrists, queer feelings in the head and perspiration are not essential to reduction of blood pressure. Medium or low frequency moderately high amperage and long time are essential factors in the treatment of cases with high blood toxicity.

THERAPY

Autocondensation is a valuable method of treatment in cases of acute alcoholism. These cases will ordinarily withstand excessive dosage. Tesla current, thin dielectric, high voltage, high amperage and time sufficient to produce profuse perspiration are the essential factors.

Anemia. Some cases of anemia are benefitted by local autocondensation over the solar plexus, but the treatment is inferior to other well-known physical therapy measures.

Aneurism. Very mild dosage of autocondensation seems to benefit aneurism of the aorta, the results being due principally to an equalization of the circulation which relieves the strain on the crippled artery.

Rheumatism. Cases of toxemia so often called rheumatism are practically all benefitted by autocondensation, the factors to be chosen with due regard to the condition of the patient.

Cold Extremities. Cold extremities are caused by vasomotor inefficiency and are benefitted by autocondensation, the essential factors being high voltage, low milliamperage, high fre-

quency and short time. The effects of autocondensation are enhanced when supplemented by the static wave current.

Diabetes. Tesla autocondensation for fifteen minutes followed by local autocondensation to the pancreas sometimes reduces blood sugar.

Headache. Autocondensation is indicated in headaches from toxic causes.

Insomnia. While autocondensation is an empirical treatment for insomnia, many cases are relieved by its use. Factors: Tesla current, low amperage, high frequency and moderately long time—twenty to thirty minutes.

Locomotor Ataxia. Many symptoms of tabes are more or less relieved by autocondensation; however, there is probably no permanent effect on the pathology.

Angina Pectoris. Cardio-diathermy is a valuable adjunct to other well-known medicinal measures. Between the attacks, if blood pressure be high, autocondensation will afford great relief.

Arteriosclerosis. Experience justifies the statement that lost resiliency of arteries may be partially restored by autocondensation; however, two or three treatments a week for many months are required. In the hyperpietic stage arterial changes may be prevented by autocondensation and proper hygienic management. After the disease is well developed and cardiovascular changes have taken place there is no cure, but much may be done to prevent further changes by keeping the blood pressure within the safety zone, this being accomplished by close observation, an occasional treatment by autocondensation and good hygienic measures which common sense will suggest.

The inroads of this disease can only be estimated by the symptoms present and these are not always a safe guide; therefore, it is advis-

able to commence autocondensation treatment with the Tesla current. The first treatment should not exceed 300 milliamperes for a period of ten minutes, and it is not advisable to exceed 600 milliamperes at any time. There is no advantage in heavy dosage. Treatments should be given every day until the operator is satisfied that no further reduction of the blood pressure is anticipated. After the pressures have been reduced to the point of fixed tension the d'Arsonval current is substituted for the Tesla current.

The d'Arsonval current will to a limited extent dissipate the deposits in the arterial walls. However, close observation is demanded to see that the absorptive effects are not overdone. The alternate use of the Tesla and d'Arsonval currents has its advantages in some cases.

It has been said and often repeated that the frequency of oscillations of the high frequency current has nothing to do with the degree of heat produced.

The writer's observations in the use of the different rates of frequency lead to conclusions as follows:

1. The higher the rate of frequency the greater the condensation of current on the surface of the body or the so-called skin effect.

2. The degree of heat developed within the tissues is in inverse proportion to the rate of frequency.

3. Extremely high frequencies have a very soothing effect on the sympathetic nervous system.

4. The lower frequencies have a more profound effect on metabolism.

5. The higher frequencies with high voltage and low amperage are indicated in the aged with arteriosclerosis.

6. The lower frequencies with moderate voltage and amperage are indicated in most cases of hyperpiesis.

7. The higher frequencies with moderate voltage and amperage seem best for cases of neurasthenia with high blood pressures.

8. Systolic pressure seems to respond better to the higher frequencies, while the diastolic pressure seems to respond better to the lower frequencies. However, to this are many exceptions.

9. The lower frequencies seem to stimulate the endocrine structures to increased activity.

10. The exceedingly high frequencies have a sedative effect on the endocrine structures.

That a proper dietetic regime, in many cases, has a favorable influence on blood pressure is not questioned, but my experience teaches that the dominant agent in reduction of blood pressure is autocondensation.

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INDICATIONS FOR THE USE OF SINE CURRENTS*

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When the transmission of heat, light, sound or any form of energy is spoken of, the natural interpretation is that it is continuous. Any interruption, interference, or deviation from a continuity of motion or transmission, opens up an entirely new proposition, as might be applied to physical actions.

For a long time the medical profession has been impressed with the fact that heat was the one essential, not only for the relief of pain, but for the dissipation and possible cure of the products of injury and disease, where nature has failed to establish restoration of impaired function. Modern devices meet these indications whereby the necessary heat can be carried and directed to a chosen part, modified in a very marked degree, and enhance the value of therapeutic methods.

The constructive effects of some of the forms of light treatment and the destructive action of others, have for a long time been greatly appreciated. The therapeutics of other methods depend upon wave impulses peculiar to their source of origin.

High frequency currents produce heat effects by resistance of the tissue to current flow, and the galvanic current produces its thermal action, plus its physiological and polar action.

Much is being said and written daily on the value of diathermy in medicine.

Use of the galvanic current, which necessarily calls for some knowledge of electro-physics, is being ignored by a large portion of physicians because they have been instructed that it is not necessary and diathermy will take its place.

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Those who are familiar with the subject know that this is a fallacy, and that enlightenment is the only cure for this state of mind.

An artist's work is successful according to the accuracy with which he imitates nature. Physiologists understand, and biologists have accurately demonstrated, that nature provides in the vegetable and animal kingdom nourishment to maintain normal nutrition of the living body.

The more accurate the indications for determining what the insufficient element may be, the more definite and scientific is the medication that follows. Again, the more accurately the fruit or vegetable containing the necessary ingredient can be adapted to the requirements of the individual, the quicker the absorption of that essential element, when taken from a vegetable, instead of a medicinal source.

If the absorption of essential food ingredients is taken according to nature's plan, sufficiently to maintain and not overstrain the organism, and according to best physiological teachings of regular periods of ingestion, digestion, and absorption, and a corresponding period of rest—nature may recover itself by the above metabolic process, other things being equal, man should live a hundred years.

Modern life, with its many deviations of maintaining existence all the way from unbalanced diet to ill fitting garments and footwear, has so distorted the original plan that the old phrase of "three score and ten" too often closes the life performance with a practical cessation of mental and physical activity, or actual demise with the majority.

The above summary of undisputable facts does not in any way help the sick, only as a

warning that humans, like vegetation, are subject to decay. Also that this degenerative process, barring accidents and acute diseases, comes sooner or later in some part of the body where something has happened to give it a start.

Because of the disappointing effect of many stimulants, and unreliability of many medicines, it behooves us to think seriously upon all means and methods to prolong existence by preventative measures. Life depends upon normal cell activity, and that cell activity varies greatly in different tissues and organs, and should be recognized as the one essential in restoring function. This point may be carried further by saying the underlying law of life itself originates and is perpetuated only through rhythmic impulses or vibrations.

The propriety of utilizing in medicine means for restoring function by the use of many processes, brought before the profession during the last twenty years should, if intelligently appreciated, be a means of prolonging existence, and bringing more comfort to suffering individuals than the whole product of the previous century of discoveries.

Thermo-therapy and photo-therapy constitute heat and light rays of varying magnitude. The x ray for therapeutic applications, because of its shorter wave length, has deeper penetrating power. The vacuum and non-vacuum electrodes excited by high frequency currents provide localized heat limited in its usefulness. Diathermy is made to produce an immense amount of heat localized in diseased areas as desired. Static electricity with its most common and valuable form of application to and over diseased areas, under the usual name wave current, has a special virtue of its own because of its ability to liberate near and distant toxemia and other forms of deleterious material. Last, but from a therapeutic point of view in the writer's opinion the most important, the direct or commonly called galvanic current.

Characteristics of the modalities mentioned may be produced by any form of mechanism that will permit heat, light or electricity caused to surge to manifest its beneficial action when applied to the body in a way that will imitate as nearly as possible the well-known physiological action of that part.

When a galvanic current is applied through a portion of the body with moist surface electrodes, up to a point of easy toleration, in a short space of time the electrons will so arrange and re-arrange their positions that a current flow is actually established from the positive to the negative pole. If this current, for instance 25 milliamperes, is applied suddenly the skin resistance will be so great as to not only cause shock and pain, but the contraction at first will actually retard the process of transmission as compared with the same amount of current having been allowed to be turned on gradually.

If the current is suddenly reversed, unpleasant shock and muscular spasm will ensue, especially about the negative pole, and the process is much interfered with. This is specially demonstrated in the use of the current, when constantly reversing itself, and whether weak or strong, the same characteristic property is always present. The one object to be attained is frustrated by this current reversal.

The application of a powerful light, the thermo-penetration variety, brought suddenly to the body will have less beneficial effect as compared with its gradual approach. The same applies to high frequency currents, diathermy, static wave current, and even mechanical vibration.

The therapeutic value of wave currents is attributed to mechanical action—exercise of muscle tissues. This is obviously for the purpose of improving local metabolism and restoration of muscle tone. That the restoration of function of a part can be brought about by increased cell activity, is an accepted fact, and the various methods used to accomplish results will always have strong advocates.

In exercising an area of impaired muscular fibre, let us try and visualize what happens: If we subject a muscle to the action of a slow rhythmic current, we obtain a contraction which starts slowly and by a gradual effort ends in a most complete contraction of which a muscle is capable. During this contraction the blood is squeezed out, the detritus and the used-up venous blood with its CO_2 is forced out of the muscle. With this slowly swelling contraction no rupture of muscular fibre is possible.

A period of gradual relaxation follows, succeeded by a period of rest. During the rest the muscle absorbs fresh arterial blood in much the same manner as a sponge. It is then in the best possible condition of nutrition to exert its maximum force, when the current again stimulates it to its next contraction. The result is improvement in volume and tone, and the nearer we can approach the physiological action between the electrodes, the more definite and simplified the work will be.

While the sine wave currents are applicable to all parts of the body, this form of therapeutics is especially useful (combined with appropriate dietetic care) in intestinal stasis. For many years the profession has believed that the low protein diet was the one essential in the medicinal treatment of intestinal auto intoxication.

Physiologists have proven conclusively that the excess nitrogenous material in the colon is an element to be recognized and combated. They realize the futility of drug cathartics and the harmful effects produced if continued. Mineral oils, combined with exercise of some sort, have become popular. Intestinal antiseptics, all the way from iodine to those of lesser importance, coated to be soluble only in an alkaline

menstrum (the intestine), also seem to have a popular place.

The curative action of such drugs as belladonna, nux vomica, quinine, and the like, on the involuntary muscle, is not dependable. It is because of the failure to accomplish our ends in this way that physical treatment is resorted to, aided in well defined area by intelligent x ray findings.

Wave currents are applied in the usual manner by moist electrodes externally or by a moist electrode externally and a metallic electrode internally, as the case demands. The size, position and shape may be adapted in keeping with the object to be accomplished. Knowledge of the proper technic and experience alone can accomplish this.

The diseases and impaired function areas that seem to be especially amenable to rhythmic impulses of the alternating current—sinusoidal—are:

Intestinal stasis, gall bladder infection (without the presence of gall stones) gastroptosis, including rectal prolapsus, rectal and sigmoid distortion.

These conditions offer a great field for the alternating sinusoidal current.

Fifty per cent of the above mentioned conditions require the use of metallic internal electrodes. The rapid alternating surging, sinusoidal current is particularly desirable when using metallic electrodes internally, for muscle exercise, because it has no polarity and consequently will not produce polar effects, burn or cause irritation of the mucous membrane.

711 Boylston Street.

HISTORY OF ULTRA VIOLET RAY THERAPY*

M. B. CIRLIN, M. D.,

ATTENDING SURGEON, PHYSICAL THERAPY DEPARTMENT, MICHAEL REESE HOSPITAL,
Chicago

Physics tells us that we owe our existence to the rays of the sun, and the primal command, "Let there be light," is better appreciated when the nature and physical properties of light are studied. The sun not only gives us light, heat, and food, but it also heals disease. It dispenses the oldest remedies known to human intelligence. It practiced the art of healing before Aesculapius.

The sun was worshipped among all peoples of antiquity. The Vedic Indians devoted hymns to the Deity. In the hymns of "Rig-veda" the poet prays to the sun, asking for the cure of jaundice, "Up to the sun shall go thy heart-ache and thy jaundice." The Greeks personified and worshipped the luminary under the name of Helios. Many ancient Greek physicians and philosophers advocated sun therapy; amongst them were Heradotus, Hippocrates, and Galen. The Romans built temples to the sun and sacrifices were offered by the priests. The Romans built *Solaria* for the purpose of taking sun baths. Pliny the elder said: "*Sol est remedarium maximum*"—the sun is the greatest of all remedies. Of all ancient peoples, the Egyptians adored the sun most fervently. To them sun therapy was known for more than four thousand years back. Undoubtedly heliotherapy was practiced during all ages, but we do know that sun therapy became dormant during the dark ages.

It was Sir Isaac Newton who paved the way to artificial heliotherapy. It was he who made the discovery of the spectrum in 1666. He, however, saw only visible radiation, namely: violet, indigo, blue, green, yellow, orange, and

red. Scheele in 1777 was on the pathway of discovering the ultra violet rays when he noted the release of chlorine and the production of metallic silver beyond the violet band. Invisible radiations were discovered simultaneously. William Herschell in 1800 discovered infra red by placing a delicate thermometer beyond the red line, while the discovery of ultra violet is given credit to Ritter, who in 1801 noted the blackening of silver chloride beyond the violet region.

Heliotherapy was employed considerably during the early nineteenth century. Hufeland treated rickets by sun rays in the beginning of the last century. Others who treated disease by phototherapy were Edwards, Loell, and Oliver. Poncent published a treatise on the "Treatment of Tuberculous Arthritis by Sunlight." Largo treated tuberculous laryngitis with reflected sunlight and was successful in many cases. Strandberg, a co-worker of Finsen, also observed favorable results in tuberculous laryngitis by using ordinary carbon arc light. Downs and Blunt did excellent work in proving the bacteriacidal action of ultra violet.

To Niels Ryberg Finsen goes the credit of being the father of modern phototherapy. Finsen was born December 15th, 1860, at Tors-haven, Stromo. Most of his youth was spent in Iceland. He studied medicine in Copenhagen and graduated in 1890. Until 1893 he was unknown, physically unfit and poor. About this time he observed that in patients suffering with smallpox, the parts exposed to light were prone to deep scars. He advised that such patients be kept out of light and when treated in this manner they recovered sooner and pitting was avoided. Other observations on light were made

*Read at fifth annual meeting American College of Physical Therapy. Chicago, Oct. 21, 1926.

by Finsen, and in 1895 he gave to the world his epoch-making paper on "The Treatment of Lupus by Concentrated Chemical Rays." Thus he employed sunlight as a stimulant, rather than considering it as an irritant as he did before. His first apparatus consisted of a hollow plano-convex lens about 40 centimeters in diameter, mounted on a tripod. The treatments were given out of doors, the sun rays passing through lenses made of quartz. The sun not being always available, Finsen sought a way of giving sun treatments by artificial means and succeeded when he used the carbon arc lamp. Through his influence light institutes were organized in Russia, England, France, and other countries. In 1903 he was awarded the Noble prize. The following year he died in the prime of his life and career, at the age of 44, a pioneer in artificial ultra violet therapy.

Before the brief but illustrious chapter of Finsen ended, another equally great chapter commenced, and that is the great work of Rollier. In 1903 Rollier opened an institute of heliotherapy at Leysin, Switzerland, in the high Alps, at an altitude of 5,000 feet, where the air is not too hot at any time during the summer, and the brilliance of the sun counteracts the cold in the winter. His work is mostly devoted to the so-called surgical tuberculosis. It is Rollier who taught us that the potency of the sun differs in different seasons at different hours of the day, different regions and altitudes. Rollier's brilliant results may partly be ascribed to the fact that his institute is situated in the most ideal location for heliotherapy. Nevertheless, we must admit that it is chiefly the extraordinary skill of Rollier that won him the success.

Recent investigation in the field of ultra violet has been of inestimable value to the medical profession. The brilliant results of A. F. Hess and his co-workers conclusively proved that ultra violet rays prevent and cure rickets. Hess has demonstrated that there is a rise in the quantity of calcium phosphate in children's

blood serum during the months of summer and spring, and a fall in the winter and autumn months, and the incidence of rickets is more prevalent during the months when calcium metabolism is low in children. Interesting as well as instructive research has been done by the untiring workers, Novak and Hollender, who have shown that there is a reduction of calcium in the blood serum in patients suffering from perennial hay fever, and that by exposure to ultra violet light, together with calcium-thyroid therapy, the calcium content of the blood becomes permanently fixed. Steenbock of Wisconsin did some excellent work along the lines of irradiation of foods with ultra violet light. Rats fed on portions of such irradiated foods receive the same results as if they were exposed to ultra violet rays.

Among the many brilliant achievements in artificial ultra violet therapy is the development of the mercury vapor lamp. As early as 1852 Jackson produced a mercury lamp. Harrison devised one in 1857 and others made mercury lamps of various descriptions. Arons, however, made the greatest advance when he invented the mercury burner in 1896. This was improved upon by Peter Cooper Hewitt in 1902. In 1904 W. C. Heraeus succeeded in fusing crystal quartz and made the quartz mercury burner which is in use at the present day. This opened up a new era in the electric illumination. Research by Kromayer, Nagelschmidt, Henry, Von Racklinghausen, Nogier, and others directed attention to the short wave radiation of the quartz lamp and its practical utilization for therapeutic purposes.

There has been considerable controversy as to the merits of the respective sources of ultra violet radiation. There is no conclusive evidence that the carbon arc light is superior to the quartz mercury vapor lamp and vice versa. It would be of inestimable value to the medical profession to have some facts ascertained; and perhaps the council on physical therapy will

soon enlighten us with such information. At present the only source of information of various modalities is the manufacturer.

The producers of the crater carbon arc lamp base the superiority of their apparatus on the fact that carbon arc burners contain all the rays of the spectrum and thereby closely resemble sunlight. Mercury quartz lamp manufacturers, on the other hand, contend that quartz burners give off a more abundant quantity of the ultra violet band and very little of the infra red region. Pacini demonstrated that by exposing

zinc sulphide to ultra violet rays, a brilliant fluorescence results and when immediately exposing it to infra red radiation the fluorescence disappears, proving that there is a conflict between ultra violet and infra red. This problem as well as the problem of dosage offers a great opportunity to the physicist.

I will close by quoting Pettenkofer: "Water is great; air is greater; but the greatest of all is light."

4805 North Kedzie Ave.

EDITORIAL

ARCHIVES OF PHYSICAL THERAPY, X-RAY, RADIUM

A Journal of Ideas and Ideals.

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Suite 820—30 North Michigan Avenue,
Chicago, Illinois

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ALBERT F. TYLER, M. D., Managing Editor

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Physical Therapy and Clinical Congress on
Physical Therapy—Hotel Sherman, Chicago,
October 31 to November 5, 1927.**

THE CARE OF THE SKIN AND HAIR

The skin is a living membrane which separates the body from its external environment.

The hair, nails and enamel of the teeth are modified skin, as is also the nervous system. The skin is then a very complex organ, of wide dimensions, and very close interrelationship with all bodily activities. The skin is subdivided into two layers—epidermis and dermis. The epidermis is composed of a layer of protective epithelium, which is alive in its lower strata. This layer rests upon a multi-papillated, richly vascular, nerve-containing and glandular zone, of varying thickness up to an eighth of an inch, called the dermis or corium. In this layer lie the hair bulbs with their adjacent oil glands, and also the coiled sweat glands. The latter are so numerous that if placed end to end (uncoiled) they would make a fine tube at least 5,000 miles long. Attached to the hair at an angle in which the oil gland lies, is a small involuntary muscle called the erector pili muscle. This is stimulated to activity by the sympathetic nervous system or that part of the involuntary nervous system which is primary in the phylogenetic sense, and closely allied to those glands of internal secretion which are activated by the emotions of fear, anger, etc. It is the contraction of these little muscles which is responsible for the erection of the hair on the back of a frightened animal, and for the production of heat—as seen in the so-called goose flesh in the chilled human skin. Beneath the true skin or dermis is the subcutaneous tissue—a loose elastic fiber of connective tissue, in the interstices of which are collections of fat, and conduit spaces for passage of nerves, blood and lymph vessels, etc. This area, the subcutis or panniculus adiposus, connects the overlying skin with underlying muscle. It is the moveable layer of the skin. In infancy it contains mostly fat, in

JOINT MID-YEAR MEETING
AT WASHINGTON, D. C.

AMERICAN ELECTROTHERAPEUTIC ASS'N
AND
AMERICAN COLLEGE OF PHYSICAL THERAPY
CARLTON HOTEL

There will be a joint session of the American Electrotherapeutic Association and the *American College of Physical Therapy* at Washington, D. C., on May 16th and 17th, 1927, immediately preceding the meeting of the American Medical Association.

The program of this meeting will consist of contributions by scientists of the United States Bureau of Standards, where an afternoon session of demonstrations and inspections of laboratories will be held, and of contributions by other eminent

workers such as Professor Matthews of Cincinnati, and Dr. Kellogg of Battle Creek, Mich., and finally, of contributions by members of both Associations, presenting a definite phase of application of physical therapy. The last afternoon of the meeting will be devoted to a clinical session at the Walter Reed Hospital, followed by a banquet and a moving picture demonstration and lantern slides of physical therapy in Europe.

The headquarters of the meeting will be at the Carlton Hotel, Washington, D. C., and programs can be had by addressing either Dr. Richard Kovacs, secretary of the American Electrotherapeutic Association, 223 East 68th St., New York City, or Dr. A. R. Hollender, chairman of the program committee, *American College of Physical Therapy*, 30 N. Michigan Ave., Chicago, or Dr. R. W. Fouts, secretary, Medical Arts Bldg., Omaha, Nebraska.

youth elastic tissue. In old age this elasticity is lost as well as most of the fat, and the skin hangs in wrinkled inelastic folds.

Biologically speaking, every living thing possesses an outer living membrane, through which and by which a successful adjustment to the environment is made. The outer layer, or ectoplasm of unicellular plants (like bacteria or germs) and animals such as the amoeba, is of great importance—since through it all pabulum must pass, and waste matters be extruded. Likewise in both plants and animals, as multicellularity develops in response to the need for specialization of activities in order that the entire mass of living substance or protoplasm may successfully cope with its environment, the outermost zone of the plant or animal evolves into that structure which is best suited to the pe-

culiar environment and needs of the rest of the corpus, whether it be plant, animal or human. Moreover there is a surprising resemblance in the structural components—as seen by the microscope—between the cellular components of such widely different organisms as plants and higher animals. A microscopical picture of the cross section of a leaf shows an outer layer of epithelial cells, overlying a zone in which sap circulates. In the sap and cells is a green pigment substance called chlorophyl, denoted by Dr. Will Mayo the most important substance in the whole world, because this substance when activated by ultra violet rays from the sunshine is capable of combining the animal waste substance, carbon dioxide of the air, with water, and thus build up starch, sugar and even higher foodstuffs (fuels) for animal consumption. We can thus see how important it is to us as humans

to understand the biology of skin—of much more importance than its use in providing us with artificial coverings, such as furs for summer use, and feathers for the hats of our future male citizens.

In the course of development of all animal organisms—the surface substances or ectoplasm—is found to provide for an ever increasing variety of functions. In man it serves as a limiting membrane, a protective covering, an important organ of general sense, the habitat of receptors of all types of energy from the environment, including the all-important invisible ultra violet radiation of the sunlight, as an essential part of the mechanism for heat regulation, and finally as an organ of secretion and excretion.

All these activities and relationships can be considered under two heads, local and systemic. Likewise the affections of the skin and hair must be considered from each viewpoint, and of the two the probability is that the systemic functions, interrelations, and affections of the skin far outweigh in importance its local conditions. This is emphasized here because few persons realize this and concentrate all their efforts or most of them in beauty culture upon the use of cosmetics, lip sticks, toilet waters, in the vain hope that they will fool the other fellow more than they fool themselves. The old bromide that "Beauty lies only skin deep" is of course entirely wrong. In order to have a healthy skin, harmonious function of the entire body must necessarily obtain. Moreover, the converse is also true—that healthy skin naturally presupposes a general state of health in the entire body.

It is unnecessary to subject the skin to any one of the numerous clasmats, hot steam packs or ice cold applications in order to make it healthy. In fact, the converse is apt to be true—that ere long the natural elasticity of the skin will be lost—and rejuvenation has not yet ap-

proached the degree of perfection described in the newspapers or pictured upon the screen. Especially should the layman beware of so-called beauty specialists or cosmetologists, face strighteners and the like. Unsightly scars may follow infection due to unskilled manipulation of the face, application of adhesive strips for so-called face lifting, and electrolytic destruction of the hairs. Properly performed by an expert—in the tediously meticulous manner which is necessary for good results, and by the invariable use of the negative pole of the galvanic current through the needle, hair destruction may be obtained. The positive pole with a steel needle should never be used, as otherwise a deposit of a black iron oxide will leave an unsightly stain in the depths of the skin. The use of the x rays as depilatory is exceedingly dangerous, especially in unskilled hands, and even when administered by experts has at times left unsightly burns which heal slowly, if at all.

Alopecia is another fertile field for beauty culturists. There are two main types of baldness, the senile type, which is incurable by present methods, and the patchy areated type, which is probably due to an infection at the base of the hair, and which can be cured in approximately 50 per cent of cases. The chief desiderata are hair bulbs not as yet so diseased as to be entirely dead, and some method whereby a tremendous counter irritation can be applied to the scalp, thus increasing the blood supply of the scalp by many fold. These can be accomplished by intensive use of the high frequency current and ultra violet radiation from a suitable quartz mercury vapor lamp. The patient must be willing to clip the hair closely in order to permit of the proper application of these energies, and to stoically stand the moderately severe "sunburn" or desquamative erythema so essential in this treatment.

The use of freckle and mole removers is fraught with danger. Freckles are localized collections of pigment in individuals who do

not tan on exposure to sunlight. They occur in blonde, so-called thyroid type of individuals. A more marked state in this same type is the individual who peels but never tans. The best treatment for these individuals is very gradual exposure or complete avoidance of sunlight. Moles and warts may be removed surgically or by the use of either electrolysis in the hands of an expert electrotherapist, or by surgical diathermy. Nail polishes and the fancy stuff used on eyelashes have been known to cause poisoning—as have also various creams and lotions. The same substance may be much more noxious for one individual than the next. A good rule is to use as little artificial beauty help as possible, and at the first sign of skin irritation omit all of them from the toilet. If the trouble continues consult a good dermatologist, or in lieu thereof the family physician.

It is of course to have been expected that the modern method of living, of over eating and under exercising, of local irritation by toxic cosmetics, and beauty specialists would extract their dermatological toll—and such is the case. On the other hand the back to nature movement, the acquisition of fresh air and sunshine, and last but not least, the utilization of various efficient physical agencies in the treatment of lesions that have developed, are compensatory factors of no mean value.

EDWIN N. KIME,
Indianapolis.

ULTRA VIOLET RAYS AND VACCINE THERAPY

The *Lancet* of January 1st contains an interesting and important contribution on this subject in the form of an editorial. Because of some new phases of ultra violet action touched upon, it was thought that it would not be amiss to reproduce the editorial as it originally appeared.

The discovery of vitamin D, the proof of the anti-rachitic value of ultra violet rays from any source, and the experimental photosynthesis of the anti-rachitic factor in cholesterol or closely associated substances, have set many theorists explaining the probable mechanism of the body's reaction to ultra violet rays. Dr. Paolo Iacchia, writing in the *Pediatria-Archivio*, essays to explain the mass of established facts of actinotherapy, and seeks a rational basis for a special line of treatment that has given hopeful results in his hands. Dr. Iacchia believes that the effect of ultra violet rays is to be explained in an increased ionization of the electrolytes dissolved in, or loosely combined with, the blood plasma. He counters the criticism that very little ultra violet light penetrates the skin by pointing out that microtome sections of skin are not comparable with the living skin and that the thickness and cornification of the skin varies in different sites and every individual. He attributes the quicker reaction of children to the ultra violet rays to the relative thinness and softness of their skin allowing a greater intensity of the incident radiation to reach the cutis vera. The liberation of Ca and P-ions in the plasma would, according to Dr. Iacchia, explain the beneficial effects of the rays in rickets, and would be in keeping with the work of Bonino, who finds that these elements are more easily dissociated in human than in cows' milk. Such theorising does not carry us very far, and the interest of the paper to medical men lies in a description of a method of treatment termed by the author "auto-bacterio-proteino-terapia," which consists in the subcutaneous injection of pus, or other infective material, rendered sterile by irradiation with a mercury-vapor lamp. In addition to pus from wounds, carbuncles, and the like, Dr. Iacchia has used sputum from cases of tuberculosis, pneumonia, etc., and infected urine from cases of pyelitis and cystitis. Ordinary pus is emulsified with distilled water, exposed to ultra violet rays for an adequate time and then injected; sputum is dried on a glass slide as a thin film, irradiated, scraped off, and emulsified as for pus; urine is centrifuged and the debris washed several times to free it from soluble salts before injection. No control of the number of organisms is considered necessary, and, apparently, no severe reactions have followed this form of treatment in Dr. Iacchia's hands. He publishes many illustrative cases and declares that after twenty years of general practice, he is satisfied that this treatment is far better than any recognized form of vaccine or foreign protein therapy. The results claimed may encourage further work on autogenous vaccines sterilized by ultra violet rays.

REPORT OF THE COUNCIL ON PHYSICAL THERAPY

ON THE SALE OF ULTRA VIOLET GENERATORS DIRECTLY TO THE PUBLIC

The Council on Physical Therapy of the American Medical Association, on the basis of the present available evidence, is convinced that the sale of generators of ultra violet energy to the public for self-treatment is without justification. The Council bases its condemnation of the sale of such apparatus for this purpose on the following grounds:

1. The uninformed public could not take the proper precautions in administering treatments and, as a result, severe general burns or grave injury to the eyes might ensue.

2. Those not familiar with the possibilities of such apparatus would be led to place unwarranted confidence in the therapeutic value of such treatment by the claims that might be made in the literature advertising such generators, and to undertake to treat serious conditions not amenable to such treatment.

3. The unrestricted possession of such therapeutic means would tend to deprive people of expert diagnosis by encouraging them to make self-diagnoses.

4. Such practice would encourage the sale of useless and fraudulent lamps which would be advertised as generators of ultra violet rays, since the public would have no means at its disposal to determine the quality or quantity of the radiant energy emitted by such lamps.

For the foregoing reasons, the Council on Physical Therapy considers as detrimental to public welfare the sale or the advertising for sale, directly to the public, of a generator of ultra violet energy. Under rule 11 of its Official Rules, the Council will declare inadmissible for inclusion in its list of accepted devices for physical therapy, apparatus manufactured by a firm whose policy is in this matter detrimental to public welfare.

JOINT MID-YEAR MEETING

OF THE AMERICAN ELECTROTHERAPEUTIC ASSOCIATION AND THE AMERICAN COLLEGE OF
PHYSICAL THERAPY

Carlton Hotel, Washington, D. C.
May 16, 17, 1927

Monday Morning Session, May 16, 1927, at 9:00 a. m.—Symposium on Electrothermic Methods.

"Surgical Diathermy—Its Status in Cancer Therapy"—Gustav Kolischer, M. D., Chicago.

"Electrothermic Methods in Inoperable Cancer of the Breast"—William H. Schmidt, M. D., Philadelphia.

"Management of Inoperable Cancer by Electrothermic Methods"—George Austin Wyeth, M. D., New York.

"Oxidation"—Prof. Albert J. Mathews, University of Cincinnati (by invitation).

"The Effects of Lower Frequencies of Radiant Energy on Some Forms of Germ Life"—William Benham Snow, M. D., New York.

Monday Afternoon Session, 2:00 p. m.—U. S. Bureau of Standards.

"X Ray Standardization"—F. L. Hunt, M. D., Washington, D. C. (by invitation).

"Sources and Methods of Measurement of Ultraviolet Radiation"—W. W. Coblenz, Ph. D., Washington, D. C.

"X Ray Treatment of Hypofunction of the Ovary"—I. Seth Hirsch, M. D., New York.

"Therapeutic Exercise"—J. C. Elsom, M. D., Madison, Wis.

The afternoon session will be concluded by a visit to the laboratories in the Bureau of Standards devoted to x ray, ultra violet, and high frequency currents. Department of Commerce.

Informal Discussion of Therapeutic Application.

Monday Evening Session, 8:00 p. m.—Banquet at the Carlton hotel. Address of the evening by Frank B. Granger, M. D., Boston.

"Physical Therapy in Europe" (lantern slides and moving pictures)—Richard Kovacs, M. D., New York.

TUESDAY

Tuesday Morning Session, May 17, 1927, 9:00 a. m.

"Adjuvant Action of Diathermy in Nasal Accessory Sinus Disease"—Frank J. Novak, Jr., M. D., Chicago.

"Application of Heat for the Relief of Pain and for Other Therapeutic Effects"—John Harvey Kellogg, M. D., Battle Creek.

"Observations on the Effects of Diathermy in Osteomyelitis"—Disraeli Kobak, M. D., Chicago.

"Peripheral Nerve Injuries, Treatment by Physical Methods"—John Stanley Coulter, M. D., Chicago.

"Physical Therapy in Redundant Colon (Hirschsprung's disease)"—Joseph N. Chausse, M. D., Montreal.

"Case Presentations, Filariasis"—Charles F. Stokes, M. D., New York.

Tuesday Afternoon Session, 2:00 p. m.—Walter Reed Hospital.

Joint session with the American Academy of Physiotherapy.

Visit to the Physiotherapy Department and clinical demonstrations.

ANNOUNCEMENT

Dr. William Benham Snow, editor of *Physical Therapeutics*, New York City pioneer teacher of Physiotherapy, will be the honor guest at the meeting of the Western Physiotherapy Association and School, held in Kansas City, April 4 to 9. Dr. Snow will hold a clinic on Thursday, and at the annual banquet will speak on "Static Electricity in the Treatment of Pelvic Diseases."

WESTERN PHYSIOTHERAPY ASSOCIATION

Preliminary Program for ninth annual session at Kansas City, Mo., April 8 and 9, 1927.
A. Bern Hirsh, M. D. . . . New York City

Physiotherapy Technician

(By invitation)

William Benham Snow, M. D. . . . New York City

The Use of Static Electricity in the Treatment of Pelvic Diseases

(By invitation)

Byron S. Price, M. D. . . . New York City

Significance of Tissue Drainage in Cellular Function

(By invitation)

Richard Kovacs, M. D. . . . New York City

Diathermy in Painful Shoulder Conditions

(By invitation)

Curran Pope, M. D. . . . Louisville, Ky.

Neuro-Circulatory Asthenia

William Martin, M. D. . . . Atlantic City, N. J.

Hepatic Stasis and Its Associated Conditions

(By invitation)

Henry Schmitz, M. D. . . . Chicago, Ill.

Some Clinical Considerations on Carcinoma of the Uterine Cervix

(By invitation)

A. David Willmoth, M. D. . . . Louisville, Ky.

Use of Galvanic Current in Gynecology

R. W. Fouts, M. D. . . . Omaha, Nebr.

Bone Tumors

T. B. Lacey, M. D. . . . Glenwood, Iowa

Further Results in the Treatment of Pneumonia in Children by Diathermy

(By invitation)

Frederick L. Wahrer, M. D. . . . Marshalltown, Ia.

Physical Therapy in Diseases of the Ear

Clinton K. Smith, M. D. . . . Kansas City, Mo.

The Use of Fulguration and Electric Coagulation in Treatment of Bladder Tumors

Leonard A. West, M. D. . . . Kansas City, Mo.

Pyelography in Diseases of the Kidney and Ureter (Lantern Slides)

(By invitation)

Ellis G. Linn, M. D. . . . Des Moines, Iowa
Sound Conduction Impairment
 (Lantern Slides)

Miles J. Breuer, M. D. . . . Lincoln, Nebr.
Various Modalities in Gynecology

Benjamin H. Sherman, M. D. . . . Detroit, Mich.
The Treatment of Deep-Seated Pain with
Physical Therapy

Jos. E. G. Waddington, M. D. . . . Detroit, Mich.
The Various Electrotherapy Modalities
and Their Special Indications

A. F. Tyler, M. D. . . . Omaha, Nebr.
Report of Two Unusual Cases of Ascities
Relieved by Diathermia

G. J. Warnshius, M. D. . . . Milton, Wis.
The Therapeutics of Hyperpyrexia with Spe-
cial Reference to Infra Red Radiation

J. C. Elsom, M. D. . . . Madison, Wis.
The Therapeutic Value of Exercise

William E. Howell, M. D. . . . Chicago, Ill.
Title unannounced

Burton Baker Grover, M. D.
 Colorado Springs, Colo.
The Quick and the Dead

W. D. Chesney, M. D. . . . Chicago, Ill.
Physical Characteristics Necessary to the
Physical Therapist

George E. Knappenberger, M. D.
 Kansas City, Mo.
The X Ray in Cardiac Diagnosis
 (Lantern Slides)

Frederick L. Nelson . . . Ottumwa, Iowa
Surgical Diathermy in Urology

W. P. Grimes, M. D. . . . Kansas City, Mo.
High Frequency in General Practice

E. N. Kime, M. D. . . . Indianapolis, Ind.
Title unannounced

S. Grover Burnett, M. D. . . . Kansas City, Mo.
Climacteric Arthritis and Obesity

Jefferson D. Gibson, M. D. . . . Denver, Colo.
Static Electricity as a General Systemic
Tonic

FISCHER APRIL LECTURE CLINIC

Program for Tuesday, April 12th:

"The Physical Treatment of Neural Syphilis; Demonstration of Methods," 10:00 to 11:00 a. m.—Curran Pope, M. D., Louisville, Ky.

"The Diathermy Knife in Surgery," 11:00 to 1200 a. m.—Gustav Kolischer, M. D., Chicago.

"The Surgical Aspects of Diathermy," 1:30 to 230 p. m.—Gustavus M. Blech, M. D., Chicago.

"Electrocoagulation of Malignancy," 2:30 to 3:30 p. m.—A. L. Yocom, r., M. D., Chariton, Iowa.

"Hemorrhoid Clinic," 3:30 to 4:30 p. m.—Frank H. Walke, M. D., Shreveport, La.

Program for Wednesday, April 13th:

"Ultra Violet Irradiations in Some Diseases of Infancy and Childhood," 1000 to 11:00 a. m.—I. L. Sherry, M. D., Chicago.

"A Demonstration of Treatment of Bladder Tumors," 11:00 to 12:00 a. m.—Lewis W. Bremerman, M. D., Chicago.

"Prostato-Vesiculitis; Center for Focal Infection! Its Reflex Activity; Examination, Diagnosis and Treatment by Physical Methods," 1:30 to 2:30 p. m.—Curran Pope, M. D., Louisville, Ky.

"Treatment of Peripheral Nerve Injuries with Physical Therapy," 2:30 to 3:30 p. m.

Tonsil Clinic, 3:30 to 4:30 p. m.

After the day's work is over on Tuesday, April 12, there will be a general fellowship gathering to which all visitors are cordially invited. There will be brief addresses by three or four of the better known men, and general discussion of interest to all.

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THE STUDENT'S LIBRARY

BOOKS RECEIVED

This column is devoted to acknowledgment of the books received. Such acknowledgment must be regarded by the sender as sufficient recognition of the courtesy until time and space permit selections to be made for review.

SURGICAL PATHOLOGY. *C. Jennings Marshall*, M. D., M. S. (Lond.), F. R. C. S. (Eng.), Assistant Surgeon to the Charing Cross Hospital and to the Victoria Hospital for Children; and *Alfred Piney*, M. D., Ch. B. (Birm.), M. R. C. S., Director of the Institute of Pathology Charing Cross Hospital. Cloth. Pp. 492 with 173 illustrations. New York: Appleton, 1925.

PRACTICAL MATERIA MEDICA. *Oscar W. Bethea*, M. D., Ph. G., F. C. S., Professor of Clinical Therapeutics, Tulane School of Medicine; formerly Professor of Chemistry and Pharmacology, Mississippi Medical College, etc. Cloth. Pp. 498. Philadelphia: F. A. Davis Co., 1926.

TRAUMATIC SHOCK. *Walter B. Cannon*, A. M., M. D., lately Lieut. Col. Medical Corps, United States Army; *George Higginson*, Professor of Physiology, Harvard University Medical School, etc. Cloth. Pp. 201 with 20 figures. New York: Appleton, 1923.

TRAUMATIC INJURIES OF THE CARPUS. *Kellogg Spedd*, S. B., M. D., F. A. C. S., Assistant Professor Clinical Surgery, Rush Medical College; Attending Surgeon Cook County Hospital, etc. Cloth. Pp. 197 with 194 illustrations. D. Appleton Co., 1925.

HEART RHYTHMS. *Paul Hudley Lamson*, M. D., Associate Professor of Pharmacology, Johns Hopkins University. Cloth. Pp. 100 with 52 illustrations. Baltimore: Williams & Wilkins Co., 1921.

SURGERY OF THE SPLEEN. *Eugene H. Pool*, M. D., Attending Surgeon New York Hospital, Clinical Professor of Surgery Columbia University; and *Ralph G. Stillman*, M. D., Clinical Pathologist New York Hospital, Assistant Professor of Clinical Pathology Cornell Medical School. Cloth. Pp. 347 with 72 illustrations. New York: Appleton Co., 1923.

BOOKS REVIEWED

ATLAS OF DISEASES OF THE SKIN. *Prof. G. Riehl* and *Prof. Leo V. Zumbusch*, with diagnostic and therapeutic notes by *John B. Ludy*, A. M., M. D., Col. Med. O. R. C., U. S. Army, Dermatologist to the Lankenau and Methodist Hospitals Philadelphia; Assistant Dermatologist to the Pennsylvania, the Episcopal, and Philadelphia General Hospitals, Philadelphia. Part I—Infectious Diseases of the Skin. Three volumes, \$25.00. P. Blakiston's Son & Co., 1925.

Translated from the original German, this atlas of skin diseases is divided into three parts: Part I comprises infectious, communicable and, in a limited sense, the parasitic diseases of the skin and their allied resemblances, such as pityriasis rosea. Part II illustrates the inflammatory diseases and Part III depicts atrophies and new formations of the skin. When translated into

English the author has increased the efficacy of the volumes by adding salient points in etiology, symptomatology, diagnosis and treatment.

In the first volume of this series attention is directed to the staphylococcal infections, particularly impetigo, sycosis, furunculosis, before considering the streptococcal (erysipelas) and communicable diseases—measles, scarlatina, chicken pox, smallpox, etc. Tuberculous lesions manifest themselves in many varieties in dermatology and many plates are devoted to their demonstration. The most common parasitic dermatological maladies are shown, as actinomycosis, trichophytina, scabies, pediculosis, etc.

In this volume 69 colored prints are given along with the summarized clinical data. For the general practitioner and student of medicine, such an atlas should

be of valuable assistance in determining the category in which to place the disease under observation. Treatment depends for the most part upon this decision.

DYSPNOEA. *James Howard Means*, Harvard Medical School. Cloth. Price \$2.25. Pp. 108 with 22 figures. Baltimore: Williams & Wilkins Co., 1924.

The fifth volume of Medicine Monographs published by Williams & Wilkins, this text complies with the high standards of its predecessors.

More and more the trend of modern medical literature is tending towards the production of small monographs at the expense of the group subject. Recognition of the fundamental sciences, anatomy, physiology and pathology, is daily developing. At first it seems that its development is taking place at the expense of clinical studies, but one has only to look to leaders in medicine to see there that enviable combination of anatomy, physiology, pathology and clinical observation constituting analytical medicine.

Dyspnoea is one of the most common of presenting symptoms. To understand the pathological physiology involved is to understand the treatment indicated. "In this monograph an attempt has been made to scrutinize the various factors, both structural and functional, which may play a part in the production of a frequent and important symptom, dyspnoea, and to indicate the analytical procedure by which those present in a given case can be identified."

A well written monograph can always be recommended to the reader, and one written by such an author as James H. Means receives our unrestricted approval.

TRANSPLANTATION OF TISSUES. *Harold Neuhof*, M. D., Instructor in Surgery Columbia University College of Physicians and Surgeons, etc. Cloth. Pp. 297 with 110 illustrations. New York: Appleton, 1923.

It is surprising that despite the tremendous amount of work on transplantation of tissues and the innumerable contributions that have emanated from the clinical and research observations for the last fifty years no volume devoted to the varieties of grafts has appeared.

This text, one of the first of the Surgical Monographs under the editorship of Drs. Lewis, Pool and Elting, presents all the varieties of skin grafts from the clinical point of view, subordinating the theoretical and scientific aspect. It has for its foundation the clinical and experimental work that has been done by the writer during the past ten years. To deal comprehensively with the subject, yet not overburden the reader with superfluous references, the bibliography was limited to work that has been done within the past twenty-five years.

The chapters have been proportioned in keeping with the practical value of the tissue grafts of which they treat. Histologically the material is divided. After discussing the general principles of tissue transplantation, histological divisions have been made: Transplantation of skin and of the cornea; mucous membrane, fat and peritoneum; fascia; muscle and of nerves; bone, cartilage and joints, and teeth; blood vessels; and organs. In each section a short analysis of the evolution of the work has been given, followed by a discussion of the histology and numerous investigations. The major portion of each chapter is taken up with the indications, contra-indications, clinical value, scope and concrete clinical value, scope, and concrete clinical application of the transplantation of that specific type of tissue.

The question of tissue transplantation at some time or another always occupies the mind of every practitioner. Being of undisputed value to those engaged in the various branches of surgery, this text should be received by other members of the practicing profession with gratitude.

MODERN TREATMENT OF HEMORRHOIDS. *Joseph Franklin Montague*, M. D., F. A. C. S., of the Rectal Clinic University and Bellevue Hospital Medical College; Lecturer on Rectal Pathology; Fellow, American Proctologic Society, New York Academy of Medicine, and New York Pathological Society. Foreword by *Harlow Brooks*, M. D., F. A. C. P., Professor of Medicine, University and Bellevue Hospital Medical College; Fellow, American Gastro-Enterologic Society, American Association of Bacteriologists and Pathologists, New York Academy of Medicine. Cloth. Pp. 296 with 116 illustrations. Philadelphia: J. B. Lippincott Co., 1926.

Like many of our most common maladies, the condition known as "hemorrhoids" is one of the simplest, but one about which we know the least. Confronted with the problem of treatment, the general practitioner suddenly realizes his deplorable ignorance. Willing to work his way out he seeks his textbooks and current articles only to find himself in a dilemma of choosing between archaic textbook methods or deciphering conflicting current methods. Accepting one of the latter methods he realizes the inadequacy of information. Discouraged, he dismisses the sufferer for lack of a simple technique, or blunders through the procedure to ultimate failure.

In the development of this monograph, the author has expended a great deal of time and knowledge. A distinguished proctologist, Dr. Montague has devoted himself to the solution of this problem, systematizing modern views in a plain discussion of facts for the general practitioner and student of medicine.

Hemorrhoids give evidence of their presence by rather definite signs and symptoms. They are pathological structure, occurring because of some existing pathological physiology. Their presence suggested by certain symptoms can be diagnosed only after adequate examination, to the exclusion of other very similarly appearing conditions. Treatment depends upon the existing pathology, condition of the patient and dexterity of the examiner. The various modes of treatment are discussed by the writer: palliative, operative, injection, radium seed implantation, and electrotherapeutic. No partiality is shown the various methods; in fact, 44 pages are devoted to electrotherapy, while 40 are given to operative procedures and 25 to the injection method. But pages cannot be used as a criterion for value.

This monograph should be welcomed by both general practitioner and patient, for from its pages much comfort will emit.

PRACTICAL PHYSIOLOGICAL CHEMISTRY. Seventh edition. *Sydney W. Cole, M. A.*, Trinity College, University Lecturer in Medical Chemistry, and Hon. Director Pathological Chemistry, Charing Cross Hospital Medical School, Cambridge. Pp. 479 with 66 figures. Baltimore: Williams & Wilkins Co., 1926.

The first edition of this text was presented to science in 1904. In this, the seventh revision, much new material appears, the result of observations made at the Sir William Dunn Institute of Biochemistry at Cambridge.

The theories underlying biological oxidations and reductions have been added. Another chapter on the analysis of blood has been included, "for the value of such analyses is proved in connection with the investigation of many pathological conditions." The chapter on physical methods now includes a description of the electrical methods for the measurement of the hydrogen ion concentration, a fuller explanation of pH, the law of mass action and the dissociation of weak acids. For the physiological chemist, and for the research laboratory this text should be of value. It is not, however, intended for clinical use by the medical profession.

RADIOTHERAPY IN RELATION TO GENERAL MEDICINE. *Francis Herniman-Johnson, M. D.* (Aberd.), Radiologist to the French Hospital, London, and to the Margaret Street Hospital for Consumption; Physician in Charge X Ray and Actinotherapeutic Department Croydon General Hospital; Diplomat in Medical Radiology and Electrorology, University of Cambridge, etc. Cloth. Pp. 211. New York: Oxford University Press, 1926.

The task undertaken by the writer is indeed great, and his manner of disposal is worthy of careful consideration. To adequately portray to the non-expert

medical reader the relation of radiology to medicine as a whole requires, besides a systematized organization of the fundamental principles, a clear, pure literary talent comparable only to an Osler or a MacKenzie. Although at times we feel as though we had reached the limits of our depth, the surface is suddenly reached and we see the light of the author's efforts.

In the first portion of the book, the writer makes incursions into the fields of physics, pathology and pharmacology. Each invasion, however, is fruitful in forming the foundation for that which is to follow. Discussing the physics of radiation naturally leads to the effect of radiation upon the normal cells. A knowledge of the general nature of disease and the action of remedies is obtained by animal experimentation.

It is just and proper that the material be given space according to its relation to the subject at hand. The radiation treatment of cancer has become an established principle in medicine. The action of light on tuberculosis has been the life work of many men. The use of radiation in uterine fibromata, non-malignant tumors elsewhere, and in Graves' disease is still challenged.

A careful perusal of this work should equip the reader with a general knowledge of the possibilities and limitations of radiotherapeutics and an understanding sufficient to comprehend current articles.

TRANSFUSION OF BLOOD. *Henry M. Feinblatt, M. D.*, Assistant Clinical Professor Medicine, Long Island College Hospital, Brooklyn; Hematologist to the United Israel-Zion Hospital; Pathologist to St. Peter's Hospital; Assistant Attending Physician to the King's County Hospital; Author Clinical Laboratory Medicine. Cloth. Pp. 137 with 24 engravings. New York: Macmillan Co., 1926.

Blood transfusion has become a recognized and much utilized medical procedure. Its technique has become so developed as to render it safe, yet it is simple.

In this small monograph the author explains the principles governing, indications for and technique of blood transfusion which should be known by every practitioner of medicine. The equipment necessary is for the most part in the hands of every doctor, but the knowledge necessary has often been neglected.

After reviewing the historical aspect of the subject, some physiological considerations relating to blood transfusions are presented. Recognition of blood groups is the secret of modern success. Heretofore, transfusions were at best a hazardous procedure, there being no knowledge of the presence of iso-agglutinins or blood groups. Blood donors depend on blood groups, but this intermediary step is frequently omitted in transfusion. There are dangers that must be recognized in blood transfusions, and there are different methods whereby

such a transfusion can be performed. The author offers for the approval of the reader a direct transfusion apparatus and technique which is superior to the majority used.

In the preparation of this monograph a critical survey of the literature has been made. References to the selected articles from which opinions were obtained have been included. The basis for the work, however, should rightfully be the personal experiences of the writer.

RADIOLOGY AND SURGERY.—In connection with gastric disease it is hardly too much to say that we owe almost everything to the radiologist. As we look back on the history of gastric ulcer in respect to its symptoms, its diagnosis, and its treatment, we must now realize that before the radiologist came to the rescue there was little that could meet with our confident acceptance. I do not doubt that more errors have been made in the diagnosis of gastric ulcer than of any other disorder. Its symptoms are mimicked with so much accuracy by other disease that it is not only the unwary who are deceived. The radiologist has put all this right, or nearly right, and has, I think, explained the cause of the so remarkable plagiarism by those other diseases which arouse gastric symptoms. It is, however, not only diagnosis that has been at fault, but also the treatment that has been based on it. How can we explain the devotion of physicians to the alkali treatment of gastric ulcer except on the assumption that the diagnoses on which such methods first were founded were erroneous?—*Moynihan, Berkeley. Brit. M. J. 2:48, July 11, 1925. Called to our attention by J. A. M. A. 85:1603, Nov. 21, 1925.*

EXPERIMENTAL PHARMACOLOGY. *Dr. Hans H. Meyer, Professor of Pharmacology, University of Vienna, and Dr. R. Gottlieb, late Professor of Pharmacology, University of Heidelberg. Second edition, translated into English by Velyien E. Henderson, Professor of Pharmacology, University of Toronto. From the seventh revised German edition. Cloth. Pp. 656 with 87 figures, partly in colors, and 2 colored plates. Philadelphia: J. B. Lippincott Co., 1926.*

The insight and unique arrangement of the authors in organizing this text, combined with their individual pedagogical methods, has resulted in the production of a work worthy of international consideration.

In discussing the experimental pharmacology as a basis for therapeutics, the authors have first considered the physiology of the organism. After understanding the normal physiology of the organism it is the recognition of an alteration in this physiology that we classify as disease. They have approached pharmacology along these lines. The effect of drugs on the

function of organs and diseased processes is considered. The object of therapeutics is to rectify some altered function or condition of an organ. The selection of a remedy must depend upon a knowledge of the physiology of the organ affected and the pharmacology of the drug to be used. This text forms, therefore, a direct preparation for therapeutics.

The arrangement that has been utilized in the presentation of this material is in keeping with the object of the text. A physiological classification of drugs is used. By systems, the pharmacology of drugs is given, considering first the normal physiology, then the altered physiology. The action of the drug in altering this perverted function is emphasized.

For a linking of pharmacology with therapeutics, this text should be especially useful, both for the student with his perplexing problems and the practitioner with his constant need of handy reference.

THE DUODENAL TUBE. *Max Einhorn, M. D., Professor of Medicine at New York Post Graduate Medical School; Visiting Physician to the Lenox Hill Hospital, New York. Second edition. Cloth. Price \$3.00. Pp. 206 with 126 illustrations. Philadelphia: F. A. Davis Co., 1926.*

The Einhorn duodenal bucket, thread and tube are well known to the medical profession. The numerous contributions that have been made to medical literature by their designer explaining their applicability have added much to our knowledge of gastroenterology. In this book the brochures have been gathered together.

The value that has been placed upon gastric analyses in the determination of gastric disease has been derogated since the advent of the roentgen ray. Heretofore, many prophesies were based upon gastric analyses that failed to materialize. The roentgen ray in the hands of some unauthorized "specialists" has taken over this function. Duodenal analysis, however, is still more complicated and uncertain than gastric analysis. The emphasis that was placed upon duodenal analyses by Einhorn and Lyon, although adversaries, has never become authentic. There are no characteristic nor standardized findings in the duodenal analyses to warrant a diagnosis of duodenal, liver or pancreatic disease being made from unexpected findings.

We must not, however, deprecate nor criticize the work that has resulted in the development of our knowledge of gastroenterological conditions. The stable facts established by the pioneers cannot be taken as a measure of the worth of their efforts. It has been in the repudiation as well as the acceptance of many of these claims that our present knowledge has resulted. Could many of us have had the same enthusiasm and vision as characterized the efforts of the author of this book, medicine might have similarly benefited by our existence.

EDEMA. By *Leo Loeb*, Professor of Comparative Pathology, Washington University. Price \$3.00. Pp. 178. Baltimore: Williams & Wilkins, 1923.

In this monograph a very comprehensive and thorough review of the literature on edema has been unified. From the text we learn of the two main schools explaining this important process. On the one hand is Martin Fischer and Eppinger who attribute great importance to the role which proteins play in the development of edema. While Fischer had mainly in view the proteins of organs proper, Eppinger places the greatest importance to the protein in the interstitial spaces. On the other hand, we have the group led by Jacques Loeb, Volhard, Veil and Fahr. The main difference between the earlier conceptions and those of Fischer concerns the character of living cells and the exchange of substances between the latter and the surrounding fluid. While Jacques Loeb assumed that cells are surrounded by a protoplasmic membrane which possesses a selective permeability, Fischer on the contrary denies the existence of such a limiting membrane and believes that the cell colloids are immersed directly in the body fluids and are therefore subject to the same laws of swelling as gelatin and fibrin.

The development of our knowledge of edema has been chiefly in the last fifteen years, "the analysis of the movement of water and dissolved substances from one part of the organism to another, of the factors which regulate the permeability of the capillaries, and of the conditions which determine the power of colloids to attract water, has much increased our knowledge." Yet there is much left unsolved. The conclusions that we now develop must necessarily be tentative, "and we must expect that additions to our knowledge in the near future will necessitate a revision of some of our present conceptions."

For a presentation of our present knowledge and conclusions concerning the development of edema, one can do no better than study the various viewpoints and substantiating principles reviewed in this monograph.

VISUAL FIELD STUDIES. *Ralph I. Lloyd*, M. D., F. A. C. S., Surgeon N. Y. Ophthalmic Hospital, Ophthalmologist to the Cumberland, Carson C. Peck Memorial, and Prospect Heights Hospitals, and the Brooklyn Nursery. Pp. 216 with 124 illustrations. New York: Technical Press, 1926.

Perimetry is a method which has been little utilized by the ophthalmologist, but "the Bjerrum idea can be adapted to the perimeter with profit and with reasonable time consumption since we are beginning to realize that retinal physiology must be the real basis of this branch of the art."

The author has presented a series of postgraduate lectures on ophthalmology and has proceeded to group these lectures in a monographic form. After first presenting an interesting history of the evolution of this branch of ophthalmology, considerable space is devoted to the discussion of retinal physiology and its application to field examinations. Retinal physiology forms the very foundation of the great majority of ophthalmological functional tests. By a study of the normal, recognition of the abnormal is more prompt. Indications for field studies in the usual office routine has been incorporated in the discussion on normal visual fields. Such a routine can be developed which is comprehensive, but not so time consuming. A discussion of the various types of perimeter leads up to Evan's direct recording Campimeter and the technique employed in its manipulation. An understanding of the effect of chorio-retinal diseases upon the central and para-central fields and field outlines aids in making a differential diagnosis. The characteristics of field effects of nerve, tract, chiasm and cerebral lesions are individually considered, separate chapters being devoted to a study of retro-bulbar diseases, lesions of the chiasm and lesions behind the optic thalamus.

Such a text, elaborating the merits of another laboratory procedure, should be of particular assistance to the ophthalmologist; for such a method can be adapted to the routine office examination only after it has first been definitely established as an integral part of the specialty from which it arises.

INTERNATIONAL ABSTRACTS

Deep X Ray Therapy. Isaac Gerber, M. D., and Simon Albert, M. D. The Rhode Island M. J., Dec. 1926.

The purpose of the article is to counteract some of the misconceptions regarding deep x ray therapy.

Today there are few radiologists who will not readily admit that high voltage x rays can produce beneficial results which were impossible of achievement by former low voltage methods. The successful application of high voltage x rays, however, has proved to be far more difficult than was at first realized. Cellular structure is apparently more sensitive to short wave, high voltage, deep therapy than to long wave, low voltage, superficial therapy. The two wave lengths are to be regarded as essentially different therapeutic agents. The true explanation of this difference in cellular response to the various wave lengths has not yet been definitely demonstrated.

Carcinomata respond to high voltage x ray therapy in vastly different ways dependent upon their morphological, histological and genetic differences. Thus, uterine and breast cancers in general, respond much more favorably than do gastric and colonic cancers. Primary growths also respond much better than secondary metastatic growths.

There is no accepted technique of application of the high voltage x rays which is routine. In a general way, the massive doses of the Germans have been given up. The daily minute dosage advocated by the French is not yet wholly accepted, but radiologists are still working on the problem.

Heavy treatment with x rays constitutes only a single factor in the treatment of malignancy. The ideal treatment of malignancy employs surgery, radium electrocoagulation, alone or in combination, as the individual case requires. The combined methods produce the most satisfactory results. In general surgery, the application of deep x ray therapy has been widespread in both benign and malignant conditions.

The authors detail numerous conditions which usually present themselves and are suitable for deep x ray therapy, before or after operation, or in inoperable cases.

High voltage deep x ray therapy in the purely medical field has been advantageously utilized in the various

types of leukemias and in the Hodgkins type of lymph oblastoma. It has also been of value in certain types of resistant bronchial asthma and chronic bronchitis.

As for the future prospects of high voltage deep therapy one finds it difficult to make any definite assertions. From what has been seen of it in its brief career of five or six years there is no question that it is here to stay as one of the most valuable means for physical therapeutics which we have at our command.

Point-Gap Sparkover Variations and Their Effect on Dosage in Superficial Roentgen Ray Therapy. A. J. Markley, M. D., Archives of Derm. and Syph., Vol. 14, No. 6, Dec. 1926.

The indirect or mathematical method of measurement of superficial roentgen ray dosage has for some years held a position of primary importance in dermatologic therapy.

In order that such a method may be universally applicable or in modern terms be "standardized," it is requisite that the formulas by means of which it is applied be composed of factors which remain constant in value under all conditions. It is now recognized, however, that in the formulas originally devised for this method and still largely used, there are certain inaccuracies which lead to considerable discrepancies of dosage when the method is applied under conditions different from those under which it was developed. One of the most important of such inaccuracies, and the only one here considered, is the use as a factor in these formulas of a point-gap sparkover of fixed length, instead of and as equivalent to the voltage passing through the tube. This is an inaccuracy because the voltage value of this factor is an inconstant quantity. The length of a point-gap sparkover induced by a high tension current is determined not simply by the voltage of that current, but also by certain other conditions. Influenced by these conditions, a point to point sparkover of fixed length may be induced by currents of widely varying voltage and conversely a point to point sparkover of widely varying length by a current of fixed voltage. The sparkover voltage relation is therefore irregularly variable instead of fixed and definite.

The more important of these conditions and the manner in which they affect particularly the point to point sparkover may be briefly outlined under the following headings: (1) The character of the potential; (2) physical state of the air; (3) corona or brush discharge; (4) variations in the shape and size of the terminals; (5) the personal equation.

The density, humidity and temperature of the air through which the spark travels are of definite importance in determining the length of point to point sparkover. Corona or brush discharge is a dominant factor in determining the length of point to point sparkover. Variation in the shape and size of the terminals between which the spark passes is a frequent cause of sparkover variations and is generally well known.

The personal equation of the operator enters definitely into the proper estimation of voltage by the point spark-gap. The rapidity with which the gap is closed, the promptness of stopping the moving point at the instant of breakover, the amount and duration of corona that is permitted, the distinction between line-surge or circuit-closing breakover and that of the actual voltage—all these factors are important and make the accurate use of the point spark-gap much less simple than it really seems.

At present, voltage determinations are best made by use of a sphere-gap, either as a permanent part of the equipment or to calibrate each machine for such various combinations of voltage and milliamperage as may be desired.

The use of the sphere-gap for this purpose is, as is well known, based on its freedom from practically all the defects of the point-gap, corrections being required only for alterations in air density which are thoroughly understood.

A practical phase of this subject, however, is the capacity of roentgen ray machines to deliver the output at which they are rated by the manufacturers; a 2-kilowatt transformer is usually stated to deliver the equivalent of a 7-inch point-gap sparkover; at sea level it will, of course, do so, but at higher altitudes this 7-inch (18 cm.) spark gap represents an increasingly lower voltage and makes it impossible to obtain under such conditions the output of roentgen ray required by modern technic.

Purchasers of equipment should be fully aware of the conditions under which they operate, and adapt their apparatus to meet these conditions.

Use of Physical Therapy in General Surgery.

Jerome L. Holzman, M. D. Northwest Medicine, Vol. XXVI, No. 1, Jan. 1927.

Three modalities only are considered: (1) Quartz light; (2) radiation; (3) diathermy.

In preoperative treatment several things are of the greatest importance. First, there is the sterilization of

an operative field with ultra violet light. It is further alleged that the tanning effect of the skin produces an immunity and a resistance to stitch infections of the skin and all infections postoperatively. Second, the stimulating, building-up effect of quartz light is a very good aid in making the patient ready for operation. Furthermore, the bactericidal effect and the stimulating reaction to postoperative infections are most gratifying.

In the non-operative group of cases, intestinal tuberculosis is considered. Authorities are quoted to prove the value of artificial light in this disease.

The use of the infra red ray is discussed as applied to fracture, bruises, burns, etc. The author finds radiation of special value in adenitis and furunculosis.

Diathermy is employed in gallbladder disease, gastric ulcer, kidney stone and other conditions where operative intervention is refused.

The work of Crile, who advocates the use of diathermy during operations, is also quoted. Crile says it prevents shock and other postoperative complications, and for that reason is valuable in bad operative risks.

The greatest contribution of diathermy is that which it affords in pelvic inflammation. Where there is an accumulation of pus, the writer still adheres to surgical procedure of drainage and uses diathermy only as a substitute or as an adjunct.

Diathermy in the Treatment of Pneumonia. **William Benham Snow, M. D. Northwest Medicine, Vol. XXVI, No. 1, January 1927.**

Diathermy, as produced by the high frequency current of d'Arsonval, is the only method that can produce heat through the body with approximately uniform temperatures.

The high frequency current by the local or bipolar method heats the tissues as it passes in parallel lines of oscillations between the opposing electrodes. There is no electrolytic action of this current.

The limit of heat transmission is skin toleration at the surface. The milliamperemeter is only a relative index, (1) because apparatus is not standardized, and (2) because the effect on the patient's heart must be the guide. Under normal conditions the toleration of heat at the surface will be the limit of dosage. The underlying tissues are not favorably affected by temperatures below 115° F.

The effects from the employment of diathermy in pneumonia, as determined by the findings, are obviously relative to the resistance of the pneumococci to heat as shown by the fact that all early cases treated by diathermy terminate by lysis, not in the usual way by crisis. The pneumococci survive under low temperatures—below freezing—but rapidly succumb to a temperature of 125° F. in ten minutes.

The administration of diathermy, with the current passing through a consolidated pneumonic process with or near the temperature at which development ceases, causes the proliferation of the pneumococcus to be arrested. It is shown, furthermore, that in the record of cases treated, except those at or about the period of resolution, the temperature may after the first administration rise a little, but then it begins to fall and continues to by lysis, indicating an arrest of the active pneumonic process. The relief afforded in cases of acute bronchitis and acute pleurisy, both of which promptly yield to from two to four properly applied administrations of diathermy, is evidence of its effects on the bacteria present in those conditions. The method of administration will depend largely upon the stage at which a case comes under observation.

In the acute stage of pneumonia, before consolidation, the treatment is pushed with as high temperatures as the skin will tolerate and with long exposures. Place two warm, moistened electrodes of soft metal, preferably of a thickness of 22 B.S. gauge and approximately 8 by 10 inches square, one over the involved lung and the other over the opposite lung, and pass the current as in acute bronchitis and pleurisy for one hour at a temperature that the skin will tolerate, which will be approximately 106° F. This should terminate the active process in the pleuritic stage before consolidation, as it does in other pulmonary affections. An administration of this sort should be applied at least twice in twenty-four hours, or better still three times on the day of the initial chill. There can be no contraindication to this procedure in patients otherwise normal as to the cardia and any other vital organs. Cases treated in this manner have a fair prospect of terminating favorably in the first days as pleurisy has. The method has been repeatedly successful in relieving the pain and lesion in acute pleurisy. Cases so relieved indicate a forerunner of what might otherwise have terminated as pneumonia. Experience has shown that the earlier cases are treated for pneumonia by diathermy, the more prompt will be the cessation of toxic symptoms and temperature, and the more certain the recovery.

To call for the administration of diathermy after the condition is far advanced and the heart is weak and irregular will militate against a favorable outcome. In an advanced case, the administration should be made transversely with electrodes 4 by 7 inches, gradually increasing the current and observing the pulse during the administration. Under conditions of a weakened or failing cardia it is not advisable to pass the current directly through the heart as advocated by Stewart, lest the depression be increased. This is well shown in the treatment of myocarditis, when a mild current administered with the cardiac responses observed, without reference to the milliamperage, will

determine the dose; whereas, an indiscriminate employment of a heavier dose will cause collapse.

Diathermy should be applied in critical cases of pneumonia with the same care as in myocarditis. The current should not be administered with the electrodes placed anteroposteriorly except in cases of bronchopneumonia. Then the operator is governed by the cardiac condition as indicated by the pulse.

In advanced cases of lobar pneumonia with cardiac depression place the surface electrodes, 4 by 7 inches, in the longer way, in such a position that the current will not pass through the cardia but across the chest in the posterior cardiac space. Surface administrations of radiant light and heat with diathermy employed as stated will greatly improve the heart's force by reflex stimulation of the deep cardiac centers from the periphery. Peripheral treatment with reflected incandescent light in critical cases will often turn the tide to recovery.

Numerous statistics are quoted by the author to substantiate his contentions. An interesting case report in point is given and the following conclusions drawn:

(1) Diathermy properly administered has demonstrated its value in the treatment of pneumonia. It is always a synergist never an antagonist, to other measures employed.

(2) Reflected radiant light and heat as a congener in a case of cardiac weakness is a valuable means of strengthening the heart's action.

(3) The established value of diathermy in the treatment of infections has won its place as an indicated measure in the treatment of pneumonia because the heat is transmitted through the body with perfect safety and already with a favorable clinical showing.

(4) In all other acute pulmonary conditions and early phthisis it plays an important role in accord with the effects of heat in conditions of infection.

The Action of Sun and Air Baths. J. D. M. Claasseus, M. D., Ch. B. (Edin.), South African Med. Rec., Sept. 1926.

The sun's rays have a direct and indirect action on the body exposed to it. Experiments with filters show that the potent radiations are the ultra violet rays.

The beneficial clinical effects of sun baths is summarized by the author in nine definite statements:

(1) Recuperation of general body vitality, a feeling of euphoria, as manifested in the face, by enjoyment of life, quickness of movements, etc.

(2) The pigmentation of the skin increases the resistance of the body to exposure, to differences in temperature, and to infections generally. Pigmented skins are less amenable to diseases of the skin. (Cutaneous diseases *per se* are rare in Kafirs.)

(3) The tonus of the abdominal and thoracic viscera is restored, and the processes of digestion are stimulated, as evidenced by the increased appetite, the improvement or cure of gastric and intestinal trouble, and by increase in weight.

(4) The internal secretions are stimulated (when deficient in quantity or quality), and the general metabolism modified in accordance with the need of the healthy organism, as shown by increase of weight in certain cases, or loss of weight in unhealthy obese individuals, with return of the menstrual functions in women.

(5) The general muscular nutrition and tone are increased, muscular development acquired, physical vigor and strength renewed. In this respect sun baths are, in my opinion, superior to a course of massage. Patients after sun-bath treatment are energetic, with great muscular development, and capable of sustained physical exertion.

(6) Direct analgesic and bactericidal effect, as proved by the fact that wounds get painless and heal quickly, the cure of staphylococcal skin infections, of chronic toxemias, and the rapid disappearance of pain in neuritic and myalgic conditions.

(7) The sun's rays have a definite ionizing lytic effect on pathologically formed fibrous tissue, as evidenced by the following facts:

Old-standing cases of neuritis (sciatica) and fibrositis (lumbago) can recover completely, without any interference of function of affected parts.

That subacute pelvic inflammatory exudates may disappear entirely.

That the scar tissue of fairly extensive healed wounds (treated by sun baths during healing) does not tend to ultimately produce the same degree of cicatricial contraction that generally occurs; the scar tissue remains thinner and more pliable.

(8) The improvement and cure of anemia and chlorosis, as shown by the improvement in color, the disappearance of such signs as headache, lassitude, general debility, etc., and the restoration of the normal menstrual functions.

(9) Acts as a great sedative and tonic to the nervous system, inducing sleep, promoting a bright spirit, a sense of optimism and renewed power for mental application.

The Effect of Ultra Violet Irradiation on the Health of a Group of Infants. Louis H. Barenberg, M. D.; Irving Friedman, M. D., and David Green, M. D. J. A. M. A., Vol. 87, No. 14, Oct. 2, 1926.

The study made by the authors was carried out in a large child-caring institution, harboring children ranging from a few weeks to 5 years of age. Experience for

many years has been that during the summer months the morbidity is low, but that during the autumn, winter and early spring, the children suffer from respiratory infections partly because of a lack of sunlight, especially of the deprivation of its ultra violet rays. In the hope of overcoming this situation, an attempt was made to ascertain whether these infections could be obviated by means of systematic exposures of a group of infants to ultra violet rays* from an artificial source. The object was primarily to determine the value of these rays in the prevention of respiratory infections and secondly on the nutrition of the children. The scope of the study was somewhat enlarged to include the value of this therapeutic agent in pertussis, varicella and adenitis.

The study of our data, especially in regard to the weight and general nutrition of the children, gives support to this point of view. For example, during the first month of irradiation, when the total exposure had been only eighty-one minutes, the children, both small and large, increased in weight to a greater extent than the corresponding group which had not been irradiated. It would seem that there is an initial stimulation from the irradiation which reaches its maximum at about this time. During the subsequent months the gains were less, in both of the irradiated groups. Where-as infection no doubt played a role in these months, it did not confuse the comparative picture during the first month of the study.

In regard to growth as indicated by increase in height, it is difficult to express a definite opinion. The variations among individuals, as the result of heredity and other factors, are so great that large numbers of observations are necessary in order to make the conclusions of value. It can be stated, however, that in the small series of children which we followed no superiority in this respect was brought about by several months of irradiation.

As stated, one of the many benefits that we hoped to derive from this ultra violet therapy was a diminution of the frequent infections to which all children are prone throughout the winter months. A glance at the tables shows the failure of our efforts. Despite irradiation, the number of infections increased after November, as is customary at this season of the year. In fact, it will be seen that the irradiated children in the ward comprising the younger infants developed a greater number of infections during the second period than the children who were not irradiated; the same is true for the older children in regard to the first and second periods. Had the result been the reverse, we might well have ascribed the benefit to the action of irradiation. The infections involved almost entirely the respiratory tract. It is evident that we cannot hope to eradicate this menace by means of ultra violet ray therapy.

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The estimations of hemoglobin that are recorded indicate that the fluctuations are more marked and that the average percentage is lower in young than in older infants. In the former group the hemoglobin remained stationary among those who were not irradiated, but even decreased in those who were exposed to the rays of the mercury vapor lamp. In the older children we note a similar result, the percentages of hemoglobin being less favorably affected in those of the irradiated group rather than in the non-irradiated. With the advent of spring and warmer weather and the absence of infection, which always accompanies this season of the year, the hemoglobin of all the children, younger and older, showed a definite increase, which is to be ascribed probably more to a lack of infection than to a change in metabolism.

As stated, owing to the outbreak of pertussis after the irradiation had been started, an opportunity was afforded for the study of its prophylactic and curative value. Gettinger recently reported his experience with the mercury vapor lamp in 12 children suffering from pertussis. His results were uniformly more favorable with irradiation than with any other form of therapy. Marked improvement was noted after the first few exposures, in regard both to vomiting and to the intensity of the paroxysms. The incidence of pertussis in both of our wards during the period of irradiation, shows that the irradiation had little or no effect. Four children in one ward and three in another developed pertussis in spite of having been irradiated for several months prior to the onset of pertussis. Had irradiation any prophylactic value, it should have been manifested after three months of exposure. No curative effect was observed in regard either to the severity or to the duration of the disease.

A coincidental outbreak of varicella occurred during the period of irradiation. Twelve of the irradiated and 14 of the non-irradiated children developed varicella. The eruption of the former group was more intensive than that of the latter.

It was of interest to note the effect of the rays on the skin. Instead of the reddish tan observed after exposure to the sun, the skin became muddy brown, a tint that persisted for about a month after irradiation. The turgor of the muscles was greatly improved; comparing the tonicity of the muscles of the poorest of the irradiated group with that of our best nourished infants, the superiority of the former in this respect was unquestionable. To judge from the texture of the skin and the firmness of the muscles, one might readily have mistaken them for breast fed infants.

During our preliminary examination, the liver, spleen or both were found to be enlarged in several of the infants. It was of interest to ascertain whether ultra violet irradiation influenced the size of these organs, especially in view of the fact that the roentgen rays

have been found to diminish the size of glandular and lymphoid organs, such as the tonsil and the spleen. Subsequent examinations showed that these organs either remained uninfluenced or were variable in size, being palpable at one time and not felt at another. Several infants who evinced no enlargement of these organs prior to irradiation were found to have a palpable spleen or liver at one or more of the subsequent examinations. This variability probably depended on the presence or absence of infection quite irrespective of irradiation.

The Germicidal Action of Ultra Violet Radiation. W. W. Coblenz and H. R. Fulton.
The Illuminating Engineer, Vol. XIX, July 1926.

Useful information on the germicidal action of ultra violet radiation is given by Dr. W. W. Coblenz and Mr. H. R. Fulton, who point out that while much literature on this subject is available, little information is given on the relation of energy available to abiotic action. They present results on a quantitative radiometric basis.

In isolating various regions of the ultra violet spectrum suitable absorption screens were employed. Advantage was also taken of the presence of a well-defined band of absorption in mica at 2,660 A.U. Tests were made on a quartz tube mercury-vapor lamp, the organism acted upon being the "bacillus coli communis."

The chief conclusions of the investigation were as follows:

- (1) Germicidal action is produced by radiation extending from the very short Schumann rays up to and including the 3,650 A.U. line—a wider range than has hitherto been assumed owing to the time of exposure not having been sufficiently prolonged.
- (2) The intensity of lethal action varies inversely as the wave length; that of wave length less than 2,800 A.U. is at least ten times more rapid than that of wave lengths greater than 3,050 A.U.—even allowing for the fact that the latter are of much lower intensity.
- (3) No difference is observed in abiotic action when the total exposure is applied continuously, or intermittently with long or short intervals of rest. The killing effect is therefore cumulative, and intermittent exposure does not have a latent effect either in stimulating growth or in continuing the lethal action during the intervals of rest.
- (4) On low intensities lethal action is greatly retarded. (On very low intensities there are some indications of stimulation instead of lethal action, but this is not fully confirmed.)
- (5) With the source of radiation used (the quartz-tube mercury vapor-lamp) the most active germicidal rays are between 1,700 and 2,800 A.U. The energy

value required to kill a bacterium is very small, being of the order 19×10^{-12} watt.

(6) In order to produce a rapid abiotic action (in one second) the radiant flux of the germicidal radiation must exceed a certain threshold value, which is of the order of 25 microwatts per square millimeter. Such may be obtained at a distance of 15 cm. from a 110-volt quartz-tube mercury arc lamp consuming 320 watts (80 volts 4 amperes).

The Alpine Climate in Summer and Winter.
Prof. C. Dorno, Ph. D., M. D. (Honorio Causa), and Bernard Hudson, M. D. (Cantab.), M. R. C. P. The Brit. J. of Tuberculosis, July 1926.

The authors review the facts with reference to mountain climates which have been known for forty or fifty years. The general features of Alpine climatic stations are also discussed. The advantages of a sheltered, elevated valley climate are admitted. These are lower atmospheric pressure; protection from wind; small amount of cloudiness; freedom from fog; cool, dry, air, free from dust and microbes; a high degree of insolation, both qualitatively and quantitatively; and a high degree of radiation.

Rarefaction of the air, temperature of the air, dryness of the air have smaller effect in summer; movement of the air, and particularly radiation, have greater. Freedom from microbes and dust is maintained throughout all seasons. Ionization of the air is greater in summer. The most important climatic factor, the demand for warmth (amount of cooling power), is in summer smaller than in winter, and this agrees with the facts known empirically that weaker individuals are acclimatized more easily in summer than in winter, and therefore can derive more benefit from a cure in summer than from one in winter.

In the climate of mountains there is a very active therapeutic agent if applied in the proper manner. In the case of pulmonary tuberculosis, the best cases for treatment in the mountains are young or middle-aged subjects of fairly good general constitution, possessed of sufficient resistance and power of reaction necessary to respond properly to the increased rate of metabolic activity which occurs at that altitude. This type of case almost invariably does well. General nutrition and health improve, and the progress of the disease is soon arrested.

It is quite an error to think that the climate of the high mountains is only advantageous to patients in the winter time. Clinical observation has made it clear to us that the summer is at any rate equally as good, and in the opinion of many of the medical men in Davos with wide experience patients actually derive more benefit and get quicker recoveries in the summer months than they do in the winter. Once a case

is diagnosed and thought to be a suitable case for the mountains, it is surely better to send him out at once and not wait until the winter is started. This statement must be qualified, however. If the patient is in an active state of illness, with high fever, it is better for him to rest in bed at home until the more active signs have disappeared. The majority of patients who come to the Alps for the purpose of getting cured from tuberculosis do not stay long enough, from three to six months being an average sojourn, even with persons who can well afford to spend the time and money. The best results are obtained by those who stay, say, a complete year, including two winters, with perhaps a short period of change of environment from time to time. While it may take a comparatively short period for marked improvement of the general health to take place, a much longer time is required for the disease to arrive at a stable state of healing. If this time is not given before returning to more or less ordinary conditions of life, a relapse is only too painfully common. Another danger of returning home to big towns and crowded cities is the liability to contract secondary or catarrhal infections. These infections appear to be caused by microbes which belong to the "filter-passing" group. While producing themselves a transitory febrile catarrh of the respiratory organs, they at the same time lower the resistance and so expose the sufferer to secondary infections—e.g., by the pneumococcus, etc.—and to any tuberculous infection already present in the lungs. How many patients who have done well during the winter in the Alps have gone down hill through these catarrhal infections caught by going home too soon! Patients should not go home for the summer, but stay in the Alps, living the outdoor life until the cure is so far complete that they can successfully stand up against catarrhal infections and the greater excitement, stress, and fatigue of home life.

In summer in the Alpine health resorts ultra violet rays are far stronger than in winter, and the skyshine there is much richer in ultra violet rays; the patient can be exposed to this and cool air in full daytime, or to the weaker sun or cool air of the early morning, and thus reap the benefit without running any risk of overdosage from these health giving rays.

The high evaporative power of the Alpine air continues to act in summer beneficially on the lungs. The air remains pure and free from the irritative dust and smoke of cities; the lovely scenery, the beautiful flowers and the charm of walks through pine woods in the Alps help to make the patient happy; while resting in the shade is delightful. While the cool Alpine air stimulates appetite, the absence of high wind protects the patient from the strain of too high a cooling power, and from the fatigue of having to walk against the wind. He can wear very light clothing, and has to suffer none of the extreme changes of weather endured at home.

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